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ELECTRIC HEATING.

Electricity for industrial heating has made great strides in recent years and will undoubtedly continue to increase in favor. There are so many commercial processes that require an even, predetermined and easily and accurately varied temperature, applied on a moderate scale, that electric heating, the ideal and embodiment of all those qualities, cannot fail to be more and more adopted.

On the other hand, the development of electric cooking devices for domestic use has necessarily been slow. Many of the appliances placed on the market were defective in materials, and had the development been more rapid the cost of replacing the defective apparatus would have been considerable. Particularly with electric ranges has the development been slow.

However, the electric heating devices now on the market are far superior to those that have been available in the past, and there is no reason why their sale should not be pushed. It seems that the fireless-cooker principle, heretofore conceded to be one element necessary to make the adoption of the electric range universal, has been successfully applied. At the recent convention of the Ohio Electric Light Association, Mr. P. L. Miles, of Cleveland, described an electric range that is being successfully introduced in Cleveland, embodying this feature. Coincident with this Mr. Roderick J. Parke, of Toronto, in a paper recently presented in Canada, described a new electric stove invented by two young Canadians which combines heat retention and automatic control.

The development of electric cooking requires more educational work than is necessary with the smaller heating appliances, and for this reason, at the present time it is necessary for the central station that desires to promote the cooking load to take the initiative in the sale of the cooking outfits. Whether it is better for the central-station company to actively engage in the sale of the devices or turn it over to local dealers, depends, of course, upon local conditions. Certainly, in either case, the central station should carry on a consistent advertising campaign.

There is quite a considerable demand for a knowledge of electric cooking among the smaller towns and in the rural districts, where many of the central stations have an exclusive field, and it is time that consistent effort be made to obtain this load. Where there is no competition of natural gas there are great possibilities for large revenues.

THE CONTRACTOR AND THE CENTRAL STATION.

At the recent convention of the National Electrical Contractors' Association, Mr. Arthur Williams, general inspector of the New York Edison Company, presented a paper entitled "The Contractor and the Central Station." Some of the views expressed by Mr. Williams are worthy of emphasis, not alone to the contractor, but to the central-station man as well. Mr. Williams is pre-eminently fitted by experience and personal qualification to give us some real food for thought. There is a very close relation between the central station and the contractor, and we entirely agree with Mr. Williams that every effort should be made by both parties to make this relation as mutually agreeable as human ingenuity and forbearance can dictate.

While the work of the central station and the contractor generally falls into well established and clearly separated lines, there are some instances wherein the functions of each overlap. Particularly in the re-sale of current-consuming devices it is possible for the central-station management to work what the contractor considers is an injury to him. The central-station management is interested in the production and sale of electrical energy. Very often it is necessary in the carrying out of a campaign looking to the introduction of current-consuming devices as a necessary adjunct to building up the central-station load that the company must strike a bargain with the customer and prospective consumer. To make them aware of the benefits that accrue through the use of electrical energy, they must, perforce, often be attracted by some tangible evidence of economy. Where a campaign which has for its purpose the introduction of heating devices, electric fans, portable lighting outfits, domestic appliances such as washers or vacuum cleaners, is projected, the contractor stands no chance whatever in the matter of meeting the central station company's price for the apparatus. However, there should be no animus upon the part of the contractor in an instance such as this. While it may deprive him of a small profit which he might make as a merchant, so long as the central station company is not interested in the wiring of the premises or the installation of the apparatus every device that is sold improves the business of the electrical contractor. Where the lines can be definitely established, however, the broader policy seems to be the best and it is well to recognize the two separate domains and provide for a logical division of the labor.

The central station and the contractor should be the best of friends. There are today electrical contractors whose current outlay involves enormous sums of money and whose reputation is such that the architect and the builder give heed and are very liable to be influenced by their judgment. Consequently, a contractor of this standing can prove to be a very good friend of a central station when it comes to a question of installing a private plant as against taking on current from the service company. The contractor is familiar also with electrical installations of every character and in many instances, if he is convinced of the integrity of the central-station management and its desire to give the consumer the greatest possible advantage for his expenditure, can induce the factory manager and shop superintendent to scrap the private plant and take on the central station service where the central station solicitor would not have a chance of explaining any of the benefits which might accrue from the change.

If the contractor is admittedly so valuable to the central station, then, as Mr. Williams puts it, let us also concede that he is due certain things from the central station. Mr. Williams holds that first and foremost he is entitled to a square deal. For business reasons as well as for absolute justice, fair and generous treatment should be accorded. If this is done in ninety-nine cases out of one hundred the contractor will pass on to his customers the impression that they too may expect a square deal from the central station and a proper adjustment of whatever differences may arise between the company who sends the bills and the consumer who pays them. The central-station company should cooperate with the contractor in having a fair, clear and impartial schedule of rates, such that the contractor can hope to obtain business under them. The central station should maintain trustworthy and competent agents in the field so that while the contractor is building up his business the central station is also building up its business.

Mr. Williams believes that the contractor has been deficient in his advertising. The central stations were accused of this a few years ago, and so much has been accomplished through the advertising done by the new-business departments of central stations that they are generally eager to interest the contractor in a similar undertaking. There is no question as to the logic of Mr. Williams' contention. The public needs education with respect to electrical wiring and the installation of every manner of apparatus and the impulse to secure the benefits of electricity must be stimulated much the same as the impulse that creates the desire for any other saleable commodity. When it is considered how many boots and shoes, how many other articles of wearing apparel both of a necessitous and of a luxurious nature, how much candy, how many summer resorts, railroad trips and how much ocean travel is advertised in competition with the matter of better lighting and more sanitary accommodations in the home, it is a wonder that utilitarian applications have made such great advances. Co-operation between the central station and the contractor whether the central station is one of the biggest in the country and the contractor only an insignificant worker in a poor district, will help to spread the network of electrical distribution, will bring the benefits of the use of electricity to those who probably have never dreamed of such an advantage, and will prove the opening wedge for the building up of a goodly revenue from a class of service not heretofore considered as possible consumers by the company.

CONVENTION OF THE OHIO ELECTRIC LIGHT ASSOCIATION.

The seventeenth annual convention of the Ohio Electric Light Association must be recorded as the most interesting and successful that has yet been held by that organization. Aided by exceptional weather and propitious surroundings and with a record-breaking attendance, the program was carried through without mishap. The facilities for meeting and for making exhibits have been much improved since the last convention and some thirty exhibitors took advantage of the opportunity to place their specialties before the eyes of the central-station men.

The sessions of the convention for the reading of papers were well attended and the discussions brought out many interesting points in the experiences of the different companies. Interest did not flag until the closing session.

The value of such conventions to the central-station men in the opportunities given for exchanging experiences and getting new ideas can hardly be overestimated, and this is being more and more appreciated every year. No company is too small to have representation, and the progressive ones send as many men as possible. It is worthy of note that the Greenville Electric Light & Power Company sent fourteen men to the convention this year.

The entertainment features of the convention were exceptional. The Association made a considerable outlay in entertaining all those at the convention on three successive evenings. These dinners formed the vehicle for getting every one together for a most enjoyable evening and proved a great success.

Great credit is due the indefatigable secretary of the Association, Mr. D. L. Gaskill, for making such complete arrangements and carrying them through with success.

ELECTRICAL FIRES AND ACCIDENTS.

Despite the increasing familiarity with electricity which accompanies its larger use year by year, the number of casualties occurring annually emphasizes the necessity of eternal vigilance, not only on the part of the general public, but of workmen employed in construction and repairs on public utility systems. A recent survey of causes of accidents and fires connected with electrical operation teaches at least one imperative lesson—caution in dealing with the invisible agency which is doing so much to benefit the world. A wholesome respect for every wire and piece of apparatus should be manifested by everybody. The pity of it is that so many of the electrical casualties might have been prevented if reasonable precautions had been taken!

It is unnecessary to again review the primary causes of accidents and fires which re-appear year after year in the reports of the insurance companies, municipal inspection departments, and elsewhere. It is the old story of careless use of tools around live conductors, hasty boring of holes through partitions carrying charged cables, slipping of wrenches and pinch bars in the vicinity of busbars, third rails and other exposed parts of circuits. Leaving electric heating apparatus by itself with the current flowing, cutting out fuses by copper jumpers run across the terminals, driving nails through protecting tubes, handling loose wires in the street, the neglect of leakage of water upon live circuits and the use of motor starters in bad condition, present nothing new from the technical standpoint. Yet in a single municipality these and similar causes resulted in thirty-four accidents last year, including four fatalities, and over sixty fires were directly traced to electrical conditions which for the most part were due to neglect. The percentage of electrical fires and accidents is indeed small when compared with other causes, the annual fire-loss from electrical failures being estimated at less than $50,000, but there is still room for improvement inside the field of electrical operation and construction.

COMPARISONS OF CENTRAL-STATION PRACTICE.

One of the best features of state supervision of electric railway, lighting and power companies is the necessity of making accurate returns of operating cost and revenue at periodical intervals to the tribunal charged with regulating responsibilities. Perhaps nothing has done so much to encourage better accounting within the companies of medium and smaller size. Regulation has its inconveniences, without doubt, but to the central-station man interested in making statistical comparisons of neighboring properties, the better class of returns offers material of the utmost value. Such data were often interchanged before the days of commission jurisdiction, but the grouping of figures along standard lines which facilitate intelligent inquiry and comparison is a comparatively late development.

By reducing gross earnings to a per capita basis, properties of widely different size, but in comparable communities can be contrasted. Similarly, data based upon the kilowatt capacity of the generating stations are highly suggestive as to the use made of the company's investment, if expressed in such terms as the ratio of the connected load to the station rating, the yearly income per dollar invested, the kilowatt-hours sold per kilowatt of station capacity, the station rating in watts per capita, and other similar data. There is, of course, nothing new in emphasizing the value of unit comparisons of central-station practice, but surprisingly few have thus far been published. It is true that local conditions must be considered in making unit comparisons, since a city having many and diversified industries absorbs electric service along different lines from a town having one or two dominant lines of manufacture or trade. Gross earnings of $10 per capita may mean a less general use of electricity among all consumers in one case, than in another where the earnings are $4 or $5 per inhabitant. With due allowances, however, the unit method is of the greatest value to the analyst of electricity-supply revenues and costs.

More Wire Men Fined.

Philip S. Dyer, another defendant in the wire trust indictment cases, in which thirty-seven men pleaded nolo contendere on July 25, and were fined by Judge Archbald $1,000 to $1,700 each, made the same plea last Thursday morning. The plea was accepted, and Dyer was fined $1,000. Dyer is secretary and treasurer of the American Horse Shoe Company.

William Rand, counsel, appeared before Judge Archbald in the afternoon, and after withdrawing the pleas of not guilty by Dana R. Bullen, head of the supply department of the General Electric Company, and Wallace S. Clark of the Rubber-Covered Wire Association, entered pleas of nolo contendere. Judge Archbald fined Bullen and Clark $1,000 each, and imposed the same on Henry A. and Henry D. Reed of the Bishop Gutta Percha Company.

Lawyer Brown then entered a plea of nolo contendere for Richard W. Comstock, vice-president of the Rhode Island-Perkins Horse Shoe Company. He said Mr. Comstock is ill in Providence, R. I., and that the indictment hanging over him is aggravating his condition. Judge Archbald accepted the plea and imposed a fine of $1,000.

Mr. Brown sought in the same way to enter pleas of nolo contendere for Francis W. Carpenter, president of the Rhode Island-Perkins Horse Shoe Company, and Herbert O. Phillips, head of the Phillips Insulated Wire Company. As it was not asserted that these defendants were unable to appear, Judge Archbald said he would not accept the pleas, but would keep the matter in abeyance until District Attorney Wise could make inquiries regarding the ability of the defendants to appear.

Electrolysis Investigation in Chicago.

The Chicago Bureau of Public Efficiency has issued a report of its investigation of damage done to underground piping of all kinds from electrolysis caused by stray currents of the traction systems in the city. A preliminary survey was made that disclosed considerable damage to water and gas pipes. A complete electrolsis survey of the city is recommended in order that appropriate measures may be taken to stop further destructive action.

The report comes somewhat late, however; first, because a few days before the publication of the report the mayor anticipated its recommendation by appointing Ray Palmer to make such a survey; second, because it recites conditions found early in the year. The rehabilitation of the surface traction systems in Chicago has progressed greatly this year and before its close practically all the street car lines will have been rebuilt. In this rebuilding extraordinary precautions to prevent stray currents leaving the return circuit have been adopted. The heaviest rails known in street-car service, 129 pounds per yard, are used; these are electrically welded into a continuous conductor of exceptionally low resistance; a 1,000,000-circular-mil copper cable is laid between the tracks and bonded to the rails as a further safeguard, thus insuring the most perfect return circuit to be found anywhere.

Electric Club of Chicago.

The Electric Club of Chicago held its regular meeting and luncheon on Wednesday, July 26, when James H. Delaney, contract agent of the Cosmopolitan Electric Company, led in the discussion of the qualifications of electrical salesmen. Mr. Delaney had formulated a series of questions regarding the qualifications of salesmen and these had been submitted to a number of purchasing agents connected with large manufacturing and railroad interests in Chicago. The reading of the communications precipitated an earnest discussion which was highly enjoyed.

It was decided to dispense with the customary picnic this summer, and it was also decided that the Club would not hold any meetings during August, but would convene on Wednesday, September 13, for its fall campaign.

Chicago Subway Board Named.

Prospects for a subway system for Chicago were materially strengthened by the appointment by Mayor Harrison, on July 27, of three prominent Chicago engineers to design a suitable subway for the city. City Engineer John Ericson, E. C. Shankland, designing engineer, and James J. Reynolds, operating engineer, compose the commission.

This action follows closely the public hearings given numerous subway plans of different engineers by the City Council. It is the intention of the new subway commission to study the various schemes proposed including that of Bion J. Arnold, until recently city subway engineer, and report to the Council at an early date.

Westinghouse Electric Elects Directors.

At the adjourned meeting of the stockholders of the Westinghouse Electric & Manufacturing Company, held July 29, for the purpose of hearing the report of the committee appointed the previous Wednesday to count the proxies, it was announced that the administration had been successful upon every point. The following directors were chosen: James S. Kuhn, Edward M. Herr, Pittsburg; Edward F. Atkins, Boston; Charles T. Brooker, Ansonia, Conn. Harrison Nesbit of Pittsburg was elected a director to fill an unexpired term.

Robert Mather was chosen chairman of the corporaton and the following officers were elected:

President, Edward M. Herr; vice-presidents, Loyall A. Osborne, Charles A. Terry and Harry P. Davids; acting vice-presidents, George W. Hebard and H. D. Shutte; controller and secretary, James C. Bennett; treasurer and assistant secretary, T. W. Siemon; assistant secretary, Warren H. Jones; assistant treasurer, H. F. Baetz; acting assistant treasurer, S. H. Anderson; auditor, F. E. Craig, and assistant auditor, W. B. Covil, Jr.

Mr. Herr has since 1905 been vice-president of the company in active charge of its manufacturing commercial operations. Vice-Presidents Osborne and Terry are re-elected, and Mr. Davis, who for some years has been manager of the engineering department at the Pittsburg works, is now made vice-president in charge of manufacturing and engineering. Calvert Townley has been appointed assistant to the president.

Edward F. Atkins, who was elected president to succeed Mr. Westinghouse a year ago, and who has been relieved of the duties at his own request, will continue an active member of the board of directors.

Chicago Elevated Railways.

The Chicago Elevated Railways Company, which is the name of the new company just formed to take over the four elevated railway systems in Chicago, will probably take over the control of the properties on September 1. It is understood that over ninety-six per cent of the stock of the old companies has been deposited under the merger proposition.

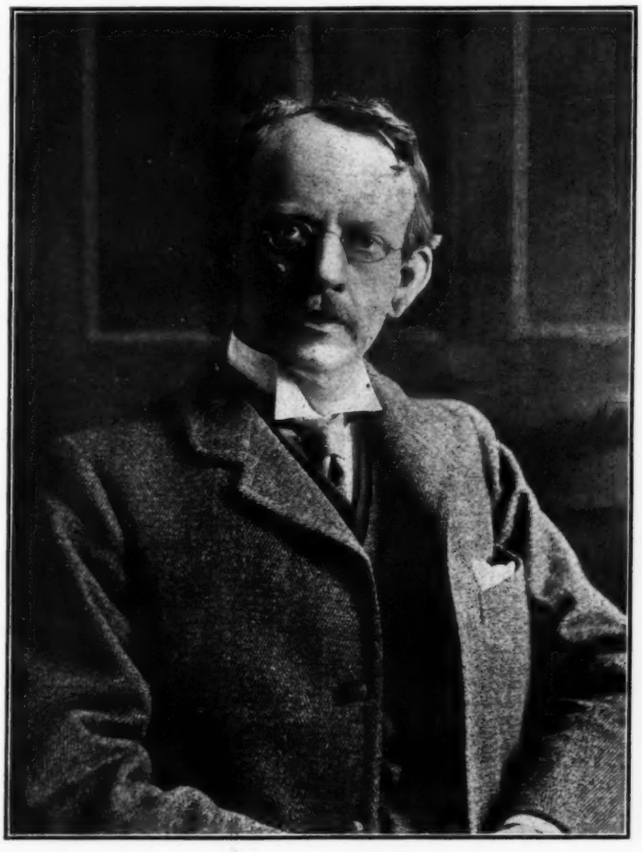
Sir J. J. Thomson.

John Joseph Thomson was born December 18, 1856, at Cheatham Hill, near Manchester, England. From 1871 to 1876 he studied at Owens College, Manchester. In the latter year he entered Trinity College, Cambridge, graduating with high honors. He became a Fellow of Trinity in 1880. In 1882 he was appointed assistant mathematical lecturer at Trinity and gained the Adams prize for an essay on the "Motion of Vortex Rings." During 1884 he was elected a Fellow of the Royal Society, and upon the resignation of Lord Rayleigh became Cavendish Professor of experimental physics in Cambridge University, which post he still holds.

In 1887, Professor Thomson delivered the Bakerian lecture on "The Dissociation of Some Gases by the Electric Discharge," before the Royal Society. This was followed by other papers on similar subjects in which were laid down the fundamental views which have led to a remarkable series of discoveries upon dissociation and the conductivity of gases.

In 1894, Professor Thomson was awarded the Royal Medal, and in 1902 he received the Hodgkins prize of the Smithsonian Institution, Washington, D. C., for his investigations on the conductivity of gases, especially on the gases that compose atmospheric air. In the same year he received the Hughes Medal of the Royal Society of London. In 1905, Professor Thomson was given the Professorship of Natural Philosophy in the Royal Institution, and in the year following he was awarded the Nobel Prize in physics. He was created a Knight in 1908, and has received numerous distinctions from scientific bodies both in Great Britain and abroad. He is an LL. D. of Glasgow, Aberdeen, Johns Hopkins and Princeton, a D.Sc. of Oxford, Dublin, Victoria and Columbia (N. Y.), as well as a Fellow of numerous other learned and scientific societies. He founded the Cavendish Laboratory Physical Society and was president of Cambridge Philosophical Society, as well as Section "A" of the British Association in 1896, and of the British Association at its Winnipeg meeting, in 1909.

He has contributed very frequently to the scientific press and is the author of many epic-making papers and text books. His principal published works include a "Treatise on Electricity and Magnetism," "Applications of Dynamics to Physics and Chemistry," "Elements of the Mathematical Theory of Electricity and Magnetism," "Recent Researches in Electricity and Magnetism," "Treatise on the Nature of Vortex Rings," "Properties of Matter," "A Textbook of Physics," "Conduction of Electricity Through Gases," "The Corpuscular Theory of Matter," "Discharge of Electricity Through Gases," and "Electricity and Matter."



SIR J. J. THOMSON,
Cavendish Professor of Experimental Physics, Cambridge.

Petroleum and Its Effect on Magnetic Disturbances.

In Bulletin 401 of the United States Geological Survey, entitled "Relations Between Local Magnetic Disturbances and the Genesis of Petroleum," by George F. Becker, the condition of knowledge with reference to the origin of petroleum and other bituminous substances is reviewed. Some oils, says Mr. Becker, are undoubtedly organic and some are beyond question inorganic. They may have been derived from carbonaceous matter of vegetable or animal origin, and they may have been derived from carbides of iron or other metals. It is also barely possible that the hydrocarbons exist as such in the mass of the earth.

While studying the subject, Mr. Becker was led to inquire whether any relation could be detected between the behavior of the compass needle and the distribution of hydrocarbons. Not much could be expected from a comparison of these phenomena, for magnetite exerts an attraction on the needle whether this ore occurs in solid masses or is disseminated in massive rocks; moreover, many volcanic rocks possess polarity. In glancing over a map of the magnetic declination in the United States, Mr. Becker found that the irregularities of the curves of equal declination of the compass were strongly marked in the principal oil regions. The most marked agreement is found through the great Appalachian oil field, which is the area of greatest variation in declination. In California, also, strong deflections accompany the chain of hydrocarbon deposits. These observations are to some extent also supported by conditions in the Caucasus, where great magnetic disturbances exist.

While the theory of the inorganic origin of the hydrocarbons is not proved by this study, yet the contention that great oil deposits are generated from iron carbides is strongly borne out by a study of the map of magnetic disturbances in the United States. The map shows that petroleum is intimately associated with magnetic disturbances similar to those arising from the neighborhood of substances possessing sensible magnetic properties, such as iron, nickel, cobalt and magnetite.

Electric Underground Railway in Rome.

The municipal government of Rome, Italy, is considering the construction of an underground electric railway. This is but another instance of the determination of "the eternal city" to keep abreast of the times.

Colorado Electrical Show.

The second annual Electrical Show of the Colorado Electric Club will be held in the Denver Auditorium during the week of October 14 to 21 inclusive.

The financial end of the show will be handled somewhat differently this year. The stock company which was formed and which figured in the distribution of the earnings of the first electric show has been dissolved. The Colorado Electric Club, which has since become a corporate body, under the state laws of Colorado, will be in complete charge of the exposition. The profits will be divided in a co-operative manner. The Electric Club and the exhibitors will receive equal shares.

Much space was devoted to Colorado's hydroelectric and mining resources at the first exposition, but it is planned to produce them on a more extensive scale this year. For that reason all mining machinery exhibits will be removed to the basement of the Auditorium. An effort will be made to make this feature as nearly realistic as possible. Numerous underground tunnels and subways depicting the interior workings of a mine will be attempted. Here the mining machinery will be shown in actual operation.

Another feature which will be thoroughly exploited is the exhibition of electrically operated farm machinery. The electric pump will receive special attention. Colorado possesses a wealth of arid land which is rapidly being reclaimed and turned into profitable farming sections through the agency of the electric pump. In this connection a miniature farm plot will be constructed in the basement of the Auditorium, where a sort of educational campaign will be conducted for the farming element visiting the exposition. Information to all interested parties will also be given at this exhibit.

The street lighting effects of last year, which were the most spectacular ever witnessed in Denver, will be reproduced on a more lavish scale. The plans of the illuminating committee, although not yet made public, are conceded to be far superior to the gorgeous electrical illumination which electrified Denver residents last year. Special features will be made of the Jovian emblem. J. F. Dostal is in charge of the street lighting committee, which includes practically the same men who formulated last year's plans. This is sufficient assurance that the street effects will outdo those of last year.

The interior decoration and illumination will be much the same. The ceiling of the Auditorium will be decorated in a riot of colored lamps which will be made to give the effect of a starry heavens. The large electrical curtain portraying a Pike's Peak sunset and which scored one of the many "hits" at the last exposition, will be replaced with a "Dancing Vaudeville Girl." This is a remarkable illusion and promises to be a fitting substitute for the mountain creation. Twelve hundred lamps, having a candle power of 48,000, will be used in producing this effect. The booth arrangement, on which the management of the show was highly complimented last year, will remain the same.

The Colorado Electric Club recently gave a luncheon at the Albany Hotel at which representatives from every industrial organization in Denver were present. The plans for the coming exposition were outlined and a movement was started whereby the electric show is assured of the combined support of these bodies. It is thought that the Denver Chamber of Commerce will endeavor to boost the electric show throughout the country.

The following board of directors will be in charge of the second Electrical Exposition of the Colorado Electric Club: W. P. Carstarphen, Jr., president; H. L. Wolfenden, vice-president; Walter F. Brown, second vice-president; C. F. Oehlman, secretary and treasurer; W. G. Matthews, Clare N. Stannard, B. S. Manuel, J. Frank Dostal, Irving Hale, John F. Greenwalt, Joseph F. Reardon.

Long Acre Lighting Company in New York City.

The Long Acre Electric Light & Power Company, of New York City, which has a capital of $2,500,000, has received authority from the Public Service Commission of New York to issue bonds to the amount of $50,000,000. The company is to issue at once $2,000,000 in stock, and bonds to the amount of $4,000,000; these bonds to be issued under a mortgage of $50,000,000, of which the Empire Trust Company is trustee.

This action evidently means strong competition with the New York Edison Company and considerable activity in electric lighting circles on Manhattan Island. Ex-Senator James F. Shaw, Boston capitalist and president of the Long Acre Company, on being interviewed, said: "We intend to develop and exercise our franchise and have secured all the capital necessary to do so." Mr. Shaw further stated, in response to an inquiry: "All rumors that the Long Acre Company is negotiating with the New York Edison Company for the sale of its franchises are absolutely erroneous.

The franchise of the Long Acre Company, in association with that of the Manhattan Transit Company, which owns the former company, is a very broad one, and has been approved by the Court of Appeals, and now by the Public Service Commission. Some $10,000,000 worth of bonds have already been subscribed for, and the officers of the Long Acre Company expect to be supplying electric light and power throughout Manhattan Island on a greatly enlarged scale at an early day.

Suits Against Electrical Manufacturers to be Settled?

It is understood that attorneys for the manufacturers, against whom indictments have been brought by the Federal Department of Justice, alleging participation in a so-called electrical trust, have submitted to the Attorney-General a decree which it is said they are willing to have entered against the alleged combination in the Government's suit for dissolution. Some very important moves have been made recently and it is expected that the companies involved are now in a position to meet with the requirements which will be indicated by the Attorney-General's office, and it is said that with some possible modifications the proposition as submitted by the companies' attorneys will be acceptable to the Department of Justice.

Trip Abroad for Edison.

Thomas A. Edison sailed on the *Mauretania*, on August 2, for his first European trip in twenty-two years. Mr. Edison had made his arrangements very quietly, and the announcement of his departure came in the nature of a very general surprise.

Exports of Copper.

Exports of copper for the week ended July 27 were 10,152 tons; and since July 1, 32,125 tons.

Electrification of a Rand Gold Property.—I.

The Power Plant of the Randfontein Group of Mines.

There are few gold mining properties in the world so well placed for electrification as those situated on the Rand in South Africa. From Springs to Randfontein, a distance of fifty miles, is one compact gold field consisting of gold mines either producing or in the course of development. For the purpose of generating the power there is also an abundant supply of coal within easy reach, but where the coal fields overlie the gold field as for instance in the Far East Rand and the coal is very inferior, for this reason coal from the more distant fields, near Middelburg, is generally used though the haulage costs from $1.60 to $1.80 per ton. The first power generating station was placed at Brakpan, where the supply of coal was considered inexhaustible; but the coal seam gave out; the colliery closed down and although there is an abundance of other coal in the immediate neighborhood it is less suitable and too inferior to compete with the Middelburg coal some fifty or seventy miles away. A large power company, known as the Victoria Falls Power Company, which —as the name implies—contemplated obtaining its motive power from the Victoria Falls on the Zambesi River in Rhodesia, has acquired the older power stations and by additions and the erection of other large stations is preparing to supply power and compressed air to any mines requiring same on the Rand. Many mines are already using this power and the majority of the gold mines are being electrified from one end of the Rand to the other, it being only a few of the older and short lived mines that will not be entirely driven electrically. Of late there has been a tendency to amalgamate the mines on the Rand on a somewhat extensive scale, in fact, on such a large scale that where the amalgamated mines are not interested in the Victoria Falls Power Company, they find it to their advantage to generate their own power and are erecting and extending their power stations for that purpose.

The electrification of the whole of the Rand was a big undertaking on the part of the Victoria Falls Power Company, and naturally many disappointments have had to be suffered. The company, likewise, has met with various drawbacks but good progress is now being made with the changing over from steam to electricity and by the end of the year everything ought to be running smoothly and well.

There are two conspicuous instances where large companies have preferred to generate their own power rather than purchase it from the Victoria Falls Power Company, namely the Randfontein group of mines on the

INTERIOR OF RANDFONTEIN GENERATING STATION.

western extremity of the Rand and the East Rand Proprietory Mines, and in both instances the results would seem, so far, to have fully justified this step.

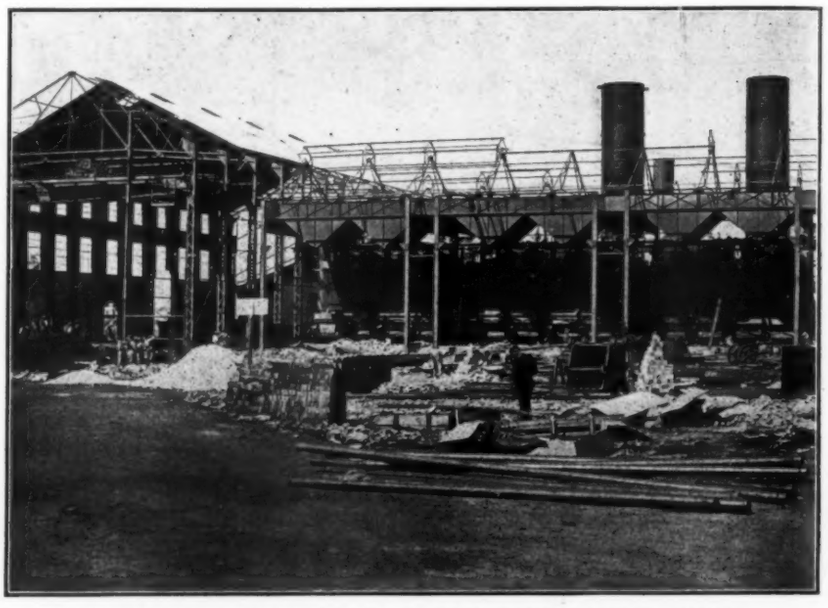
It was in 1907 that the Randfontein group of mines took the matter in hand and established a station of 2,000-kilowatts capacity, the original idea of starting this station being to supply power for second-stage winding in the mines but since then the use of electricity for all driving purposes in and about the mines has become so extensive that the purpose for which the plant was originally designed will probably be the last to use it. To meet the demand which has sprung up for electrical power on the property since the 2,000-kilowatt plant was started the installation has been increased tenfold. The Randfontein Central property extends for over four miles and has five main shafts from which it is intended to haul a total of about 184,000 tons of rock per month. To crush and deal with this a mill of six hundred 1,560-pound stamps all under one roof, sixteen tube mills, and the requisite cyanide plant have been installed. The present power demands of the Randfontein Central are given in the table.

RANDFONTEIN CENTRAL.

DUTY.	No. of Units.	Normal Rated Capacity per Unit	Max. sustained Load to Be Expected	Total Installed Capacity in H. P.
Rock hoists	5	800	2,500	4,000
Man hoists	5	350	1,000	1,750
Air compressors	4	800	2,400	3,200
Shaft pumps	21	75	1,000	1,575
Battery motors	30	100	2,600	3,000
Tube mills	16	100	1,400	1,600
Crushers	6	50	200	300
Conveyor belts	20	17	250	340
Coarse sand pumps	6	100	400	600
Fine sand pumps	4	125	250	500
Slime pumps	3	125	250	375
Return-water pumps	3	100	200	300
Solution pumps	6	40	160	240
Haulages	3	50	120	150
Workshops	8	25	150	200
Miscellaneous	..	...	620	704
Lights—8,000 Inc. 140 Arcs	..	...	500	650
			14,000	19,480

From the table it can be seen that the sum of the maxima of sustained loads amounted to 14,000 horsepower The diversity-factor taken was 1.4, thus giving 10,000 horsepower at the motor terminals. Raising this to a kilowatt per horsepower to compensate for all losses up to the generator, and making allowance for a nearly constant load of 2,000 kilowatts which already existed for the producing mines of the group, and which was expected to reach 4,000 kilowatts before the time the new plant had been running a year, the total sustained maximum to be dealt with amounted to 14,000 kilowatts at the generators. Allowing for station auxiliaries, which, with the exception of feed pumps, would be electrically driven, would bring this amount to, say roughly, 15,000 kilowatts. The hoists for a considerable time would not be requiring the demand assessed to them, so that the maximum load could be taken as not exceeding 14,000 kilowatts for a reasonable period.

To meet this demand, the existing 2,000-kilowatt plant has been increased to 20,000 kilowatts by the addition of three 2,000-kilowatt sets and two 6,000-kilowatt sets, thus allowing a 6,000-kilowatt set to be shut down under normal conditions for repairs or inspection without overloading the balance of the plant.



SCENE DURING CONSTRUCTION OF RANDFONTEIN BOILER HOUSE.

To supply steam to this plant the existing battery of four boilers has been extended by the addition of five similar batteries, a battery consisting of four boilers each capable of delivering 17,000 pounds of steam per hour, and constituting a self-contained unit. The normal steam demand for the load anticipated would warrant the running of sixteen boilers working at about their full rated steam production, and, allowing a margin for condensing plant contingencies, twenty boilers.

This allows four boilers or about sixteen per cent to be laid off for cleaning, etc.

THE GENERAL SCHEME.

The general scheme has not been changed in any way since the original first installment of the plant was laid down in 1907 and practically the same holds good in detail with the exception that the generating and transforming units have been increased in size in proportion to the heavier load.

The general scheme involved the following: (1) generating and transmitting at 6,600 volts, three phase, fifty cycles; (2) distributing at 2,200 and 500 volts for motors, with a further transformation to 120 volts for lights and underground pump motors; (3) the adoption of underground cables as a means of transmitting and distributing; (4) the adoption of turbines of the reaction type as the prime movers; (5) the adoption of a straight-tube boiler with provision for mechanical firing and consuming the cheapest coal obtainable, and the concentration of boilers in suitable distinct units in such manner that low initial costs are combined with ability to make extensions cheaply, and without alteration to existing arrangements.

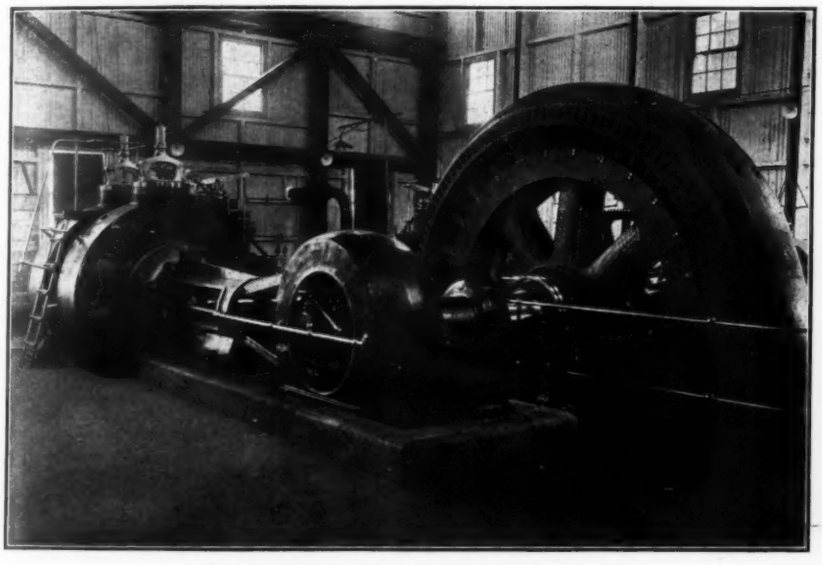
THE POWER STATION.

The selection of a site for this purpose was determined by the center of gravity of the load to be expected when the whole group of mines were equipped. No other consideration could influence the selection, since no coal mine, river, or dam existed within such distance as could affect this point.

The spot selected was near an existing coal siding, and between Nos. 1 and 2 shafts, Randfontein Central. The cooling reservoir could not be brought nearer than 400 feet from the station owing to the outcropping of the reef on the one available side and the proposed township on the other; but the general advantages of the position compensated for the additional cost of piping.

The water supply from the adjacent shafts was depended on for condensing purposes and has justified expectations, these being the two wettest shafts on the property, averaging 23,000,000 gallons per month.

Boiler-feed water has been provided for by artesian wells, of which three have been sunk and tested to 150,000 gallons per day. In addition to this a connection is now being made to the Rand Water Board's mains as a safeguard against contingencies.



AIR COMPRESSOR IN RANDFONTEIN PLANT.

BOILER PLANT.

The boilers, twenty-four in all, are of the Babcock & Wilcox "Land" type, fitted with integral superheaters and mechanical chain-grate stokers. Induced-draft plants made by Davidson & Company, and Greens fuel economizers are also provided. The feed pumps are of the Weir type, and constitute the only steam-driven auxiliaries.

Each boiler has 4,780 square feet of heating surface, and is capable of evaporating 17,000 pounds of water per hour from and at 212 degrees Fahrenheit. The boilers are arranged two in a battery, and two batteries per unit. A unit constitutes a self-contained boiler plant, consisting of four boilers, two economizers, feed pumps, induced-draft plant and stack. This design was adopted when the plant was originally laid down, since it was not known at that time, even approximately, what the ultimate capacity of the station would be. The arrangement has, however, proved an excellent one, as much of the large extension was for the original plant, so that no change has been made except that where two lines of boilers lie back to back it cheapens the outfit by combining two stacks and induced-draft plants into one. The working pressure of the boilers is 160 pounds per square inch.

The superheaters have 900 square feet of heating surface per boiler, and raise the temperature of the steam to 500 degrees Fahrenheit. Provision against excess temperature is obtained by mixing valves, which allow, when necessary, certain proportions of saturated steam to mix with the superheated steam until the desired temperature is reached. This system has given no trouble, the variations of load being such that the boilers seldom require to be forced; when, however, such occasions do arise, a little adjustment is usually necessary.

The chain-grate stokers, two per boiler, each grate five feet by twelve feet, provide 120 square feet per boiler, that is, a ratio of heating to grate surface of roughly 40 to 1.

The brickwork settings are specially arranged for the combustion of local dross coal, and the grate links are of the corrugated type which give a maximum of air inlet space without allowing the riddling of the fine dross through the grate. The stokers are driven through gear boxes having four changes of speed, which enables the travel of the grate to be varied between 5.6 and 31.5 feet per hour. The thickness of the coal can be varied from 2 to 8 inches. Motion is given to the gear wheels by roller chains driven by overhead shafting, the shafting in turn being driven by worm reduction gear direct coupled to six-horsepower motors. The drives are split up into unit sections.

Ash tunnels run under the boilers, with trucks and rails for the reception of ash and clinker deposited from chutes at the back of the stokers, and from this point the ashes are conveyed to a dump by mechanical haulage.

In addition to the main exterior bunkers of 1,000-tons capacity, each boiler house is provided with an overhead bunker of approximately 270-tons capacity. The coal gravitates to the hoppers through chutes provided with cut-off slides for regulating the supply. Coal is delivered to these bunkers by means of two gravity bucket conveyors fed from filler pits, each capable of delivering forty tons per hour. The coal is conveyed from the main bunkers to the filler pits by conveyor belts. The belts are all operated from a twenty-horsepower motor. The conveyors are driven by ten-horsepower motors separately. Dross coal having a calorific value of about 11,500 British thermal units is used. The original intention was to burn about thirty per cent of dross and the balance of nut. The Company has gradually increased the percentage of dross until only dross is now used. The average cost per ton delivered to the bunkers is about $2.55.

Feed water is obtained from three artesian wells sunk in the locality. As has beeen proved by analysis there is only one element in sufficient strength to be troublesome, viz., the CO_2 in solution. This is absorbed by lime suspended in the feed tank. The result is a thin film of lime deposited on the tubes and drums of the boilers, just sufficient to protect the surface from corrosion and not enough to appreciably affect the conduction of heat.

GENERATING PLANT.

The generating plant consists, as

mentioned, of two 1,000-kilowatt, three 2,000-kilowatt, and two 6,000-kilowatt sets. All are turbines of the Parsons multiple reaction type.

The turbines are supplied with steam at 150 pounds pressure and superheated to 500 degrees Fahrenheit. The speed is 1,500 revolutions per minute for the 1,000 and 2,000-kilowatt sets, and 1,000 revolutions per minute for the 6,000-kilowatt sets. The construction differs but little in the case of the smaller sets, the difference being that automatic by-pass valves are provided with the 2,000-kilowatt sets to admit steam to the second expansion of the turbine in case of overload.

The 6,000-kilowatt sets have the total power divided into high and low-pressure cylinders, the low-pressure cylinder constituting an exhaust-steam turbine, the steam entering at about fourteen pounds per square inch, absolute.

This construction possesses advantage over the single-cylinder turbine, enabling short shafts of good stiff construction to be utilized. The high-pressure rotors consist in this case of a solid-wheel forging, while the low-pressure rotor shaft is of similar construction, on which is mounted a steel drum. The ultimate tensile strength of both high-pressure and low-pressure rotor is not less than 30 to 35 tons per square inch.

Governing is effected by a centrifugal mechanical governor rotating on a vertical spindle and driven by worm gear from the main turbine shaft. Steam enters the steam chest and passes into the turbine through a valve. This valve is raised or lowered periodically by the action of steam pressure on the relay piston, forcing the piston against the spring and lifting the valve with it. Closing is effected by releasing the steam.

Lubrication is effected by a rotary pump driven by worm gear from the turbine spindle and maintaining an oil pressure of about ten pounds per square inch. The oil, on its return journey from the bearings, passes through a cooler, very similar to an ordinary surface condenser, and of sufficient capacity to keep the temperature of the oil below 145 degrees Fahrenheit when supplied with cooling water at a few feet head and below 90 degrees Fahrenheit in temperature.

CONDENSING PLANTS.

The condensing plants are arranged immediately below the turbine exhausts, and connected by short corrugated expansion pieces, each turbine to its own condenser. The condensers are all of the surface type, the ratio of cooling surface to steam being one square foot of surface to eight pounds of steam.

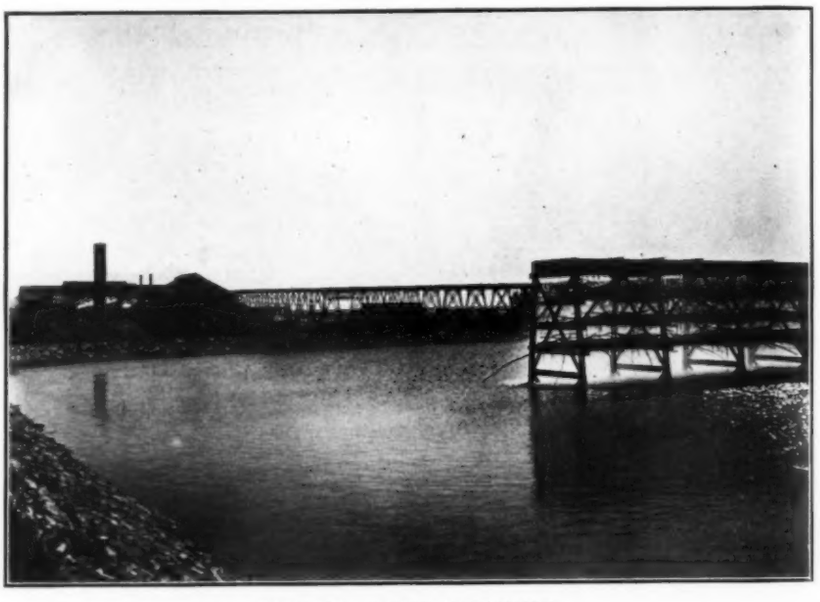
The air pumps of the 1,000 and 2,000-kilowatt sets are of the Parsons triple-compound type operating at a speed of 112 revolutions per minute. In the 1,000-kilowatt sets the air pumps and circulator are coupled to a sixty-horsepower induction motor, and the circulator direct driven, and the air pump geared. The pumps for the 2,000-kilowatt sets are driven separately, the air pump by a thirteen-horsepower motor and the circulator by a seventy-horsepower motor.

The 6,000-kilowatt sets are provided with Edwards air pumps and Worthington circulators, and are driven by 20 and 200-horsepower motors, respectively. The effective head that the circulators work against is forty feet. Each condenser is provided with fifteen per cent extra tubes to allow for fouling, and the vacuum guarantees with the additional tubes plugged up are as follows:

Absolute back pressure.	Tem. of Water. Degrees Fahr.
1.6"	70
2"	80
3"	90

The ratio of cooling water to steam is 70 to 1. The above guarantee includes the effect due to the vacuum augmentor, which is fitted to every condenser. The Parsons vacuum augmentor, is a small auxiliary condenser, having a capacity of about three per cent of the main condenser. This is connected betweeen the condenser and the air pump and in parallel with the main air-pump suction. A jet of steam from a nozzle is led into the auxiliary condenser through a suitable nozzle, and draws the non-condensable vapors from the main condenser, raising the vacuum therein and piling up the pressure in the air pump.

The cooling system consists of an open tower erected in a reservoir of 3,500,000-gallons capacity. The open tower was constructed with the first section of the plant and the closed chimney-type tower erected with the extensions. This tower is 70 feet high, 25 feet wide, and 300 feet long, and stands in a shallow trough connected to the reservoir and inlet system in such a way that both towers can be used in parallel or either cut out for cleaning purposes. Also, water collected in the trough from the inclosed tower can be, and usually is, arranged to pass into the large reservoir before going to the condensers, thus keeping all water in circulation.



DAM AND WATER RESERVOIR.

(To be continued.)

Atmospheric Disturbances to Wireless.

It has been suggested that the best method of filtering out the true atmospheric disturbance to wireless telegraphy is to work with a low aerial and large capacity.

Ohio Electric Light Association.

Seventeenth Annual Convention at Cedar Point, July 25 to 28.

The seventeenth annual convention of the Ohio Electric Light Association was held at Cedar Point, O., July 25 to 28, and proved to be most successful, the registration being close to 400. An innovation consisted of holding only one session each day, the remainder of the day being devoted to recreation. This proved very satisfactory.

The principal entertainment features consisted of the informal dinners tendered each evening by the Association, followed by music the first evening, by the magician Germain the second evening and by a vaudeville performance the third evening. On Wednesday afternoon a game of water-ball was played and on Thursday afternoon the active and associate members contested for honors on the baseball diamond. After five hotly contested innings, the central-station men won by a score of 9 to 5 and became the recipients of a handsome silver cup presented by the Duncan Electric Manufacturing Company. The winning team consisted of Messrs. Gaskill, Sloat, Ruff, Seeger C. C. Smith, Kermode, Engel, Cook, Barnard and Gardner. The team of associate members consisted of G. R. Smith, Graves, Thomas, Mallet, Moeller, Reynolds, Wisler, Bischoff, Strasburg and Howlands.

The ladies were entertained by means of musicales, card parties, a launch ride and a bowling party.

A very attractive souvenir program was gotten up by the officers. It contained a list of members and portraits of the officers and committee members.

Excellent facilities were afforded for the exhibits and a very good showing was made by those participating.

The first session of the convention was held on Tuesday afternoon, the succeeding sessions being held in the forenoon.

The opening session was called to order on Tuesday afternoon by President Beil, who proceeded to deliver the annual address. In this address he called attention to the changes in arrangements, to the increase in membership, the good condition of the finances, and the new public-utility law in Ohio. The Association now has ninety-three active members and eighty-two associate members. The new utility law, which puts electric light companies under the regulation of the railroad commission, has some unsatisfactory features and some good ones. The operating companies should co-operate with the commission, and endeavor to avoid discrimination in rates and other objectionable practices.

C. B. Wilcox, vice-president of the Sandusky Gas & Electric Company, then made an address of welcome. Major Wilcox reviewed briefly the history of electrical science and pointed out how little the general public knows of the subject. No one is in better position to educate the public than the central-station men, and they should carry on campaigns to this end.

The report of the secretary showed receipts during the year of about $4,730, the balance in the treasury being $463. The profit on the souvenir program last year was about $2,800. He commended the work of the various committees.

A paper by Waldo Weaver entitled "Why the Central Station Should Take Over the Isolated Plant" was then presented.

CENTRAL STATION AND ISOLATED PLANT.

Plants with a maximum demand up to 150-horsepower are generally conceded to the central station. There is no reason why larger plants should not also be secured as customers. The cases of Marshall Field & Company in Chicago and Walworth Manufacturing Company of Boston were cited. The ultimate result will be that 70 to 90 per cent of the isolated plants will be supplied from central stations, or else the isolated plant will be operated by the central station during the heating season and supplied from the central station at other times. Mismanagement and inefficiency run rampant in most isolated plants.

The discussion was opened by B. H. Gardner, of Dayton, who welcomed the sentiments expressed as coming from a railway man. He thought the controlling factor was one of cost, and the heating problem entered largely into this. He advocated running the isolated plant in the winter months, when heating is necessary, and using current from a central station at other times. There is much misinformation extant regarding cost of power, and it is hard to get converts to central-station power on that account.

C. I. Crippen, of Youngstown, told of an engineer who had had experience with both an isolated plant and central-station service and valued the latter principally for the relief from anxiety and trouble in running his own plant. It also permitted time to develop other parts of his business.

D. L. Gaskill, of Greenville, considered cost the determining factor. Most isolated plants do not know what it costs them to generate power. They do not run their own plants because they like it, but because they think it is cheaper. If they can be convinced that this is erroneous, they become ready customers.

W. C. Anderson, of Canton, said that it is easier to forestall a new installation than to supplant it, and recommended that particular attention should be given to new factories and extensions.

A paper was then read by O. B. Reemelin, of Dayton, on "Record Systems for Modern Central Stations."

CENTRAL-STATION RECORD SYSTEMS.

This paper describes a card system for keeping an accurate record of the physical elements of the central-station system as a basis for the proper computation of the elements entering into the financial side of operation. There is a complete set of illustrations showing the method of keeping this card system. The author emphasizes a number of points which are essential for the proper upkeep of the card system. It is especially important in underground systems to file plans and drawings showing the locations, depth and style of construction. Service drawings should be made of each installation. A map should be made of the complete system and all manholes and service boxes should be numbered. A record should be kept of every pole and a very careful record kept of the joint occupancy of pole lines.

J. T. Kermode, of Cleveland, opened the discussion by commending the system of keeping records. It is important to have them in shape to supply information quickly.

John Gilmartin, of Toledo, spoke of power-station records, which had not been included in the scheme outlined. In Toledo the service wires are not taken down upon discontinuation of service, but merely disconnected. Mr. Reemelin replied that each department kept its own monthly records. It is necessary to keep a record of disconnections, and if service is not required by a new tenant, wires should be removed.

C. C. Smith, of Bradford, stated that

telephone companies often leave wires up after disconnecting a customer and these frequently make trouble through long neglect. He had had trouble from leaving service wires up, and now made it a practice to take them down after being out of service for a month.

J. C. Martin, of New Wilmington, disconnects at the pole, but does not remove the wires. This enables prompt service to be furnished a later customer on the same premises, which is important where there is gas competition.

WEDNESDAY SESSION.

The session on Wednesday morning was called to order by Vice-President W. C. Anderson. The first paper was by J. T. Kermode, entitled "Advantageous Applications of Mercury-Arc Rectifiers Installed on Central-Station Lines."

APPLICATIONS OF MERCURY-ARC RECTIFIERS.

Rectifiers recommend themselves for charging electric vehicles, series lighting circuits, projection lanterns, charging ignition batteries, charging storage batteries for telephone service, and operating small motors where delicate control is necessary. For charging vehicle batteries, rectifiers are easier to operate and give better efficiency than motor-generators or chemical rectifiers. For large public garages, motor-generators are sometimes preferable. Good regulation on the line is necessary to prevent extinguishing before the charge is complete or overcharging. Where regulation is poor or interruptions likely, a small magnetic starting device may be placed on the panel. For series lighting circuits the rectifier is used with a constant-current transformer. Its only objectionable feature is low power-factor of about sixty-five per cent. Partial grounds may make trouble by "pumping" the transformer, thus causing feeding to be too frequent and line surges result. Circuits should be insulated for twice normal voltage. With projection lanterns, better light is secured and the current consumption reduced. After proper installation of a rectifier outfit, little care is required for maintenance. The cause of some of the more frequent troubles is then discussed, with methods of detection and correction. Oil-cooled rectifier tubes should be operated at about eighty degrees Fahrenheit. The life is increased by alternating periods of rest and service.

The discussion was opened by G. H. Stickney, who called attention to the fact that with an alternating-current arc a large current cannot be used without unsteadiness.

R. E. Russell spoke of other uses of rectifiers, such as charging batteries for telegraph lines and for operating switches, etc., in the central station itself, operating signals on railroads, spot lights, electrolytic baths for plating and bleaching, and X-ray coils. An efficiency of eighty per cent is secured in charging batteries, whereas with a motor-generator set it is only about seventy per cent.

W. S. Culver, in answer to a question, stated that cable should be insulated for a higher voltage when used with a rectifier, as surges sometimes occur. In Cincinnati the breakdowns occurred at the point where the cable left the mast-arm to enter the lamp. Horn gaps are used with tubes to take care of surges, but do not give complete protection.

A paper by A. M. Seeger on "Limiting the Power Demand and Voltage Variations of a Circuit by Floating a Fly-wheel Motor-Generator on the Line" was then presented.

FLOATING A FLY-WHEEL MOTOR-GENERATOR ON THE LINE.

This paper describes an installation on an ore dock in Toledo, where the average demand is only thirty-five per cent of the maximum. A rotary converter supplies direct current at 250 volts, and has a capacity of 2,000 amperes. The flywheel set is rated at 1,200 amperes and 600 revolutions per minute. The flywheel has a diameter of 102 inches, with a 12-inch rim and a 28-inch hub. The width is 28 inches. The radius of gyration is 45 inches and total weight 57,000 pounds. A change in speed of twenty per cent at 640 to 600 revolutions supplies the energy necessary for the extra peak demand of 900 kilowatts for seven seconds. The switchboard is supplied with various relays and contactors so that when the load reaches 1,500 amperes, the motor is converted to a generator through control of the series and shunt fields. The time required to accelerate the flywheel from twenty per cent below normal to normal speed is forty seconds, and the peaks are separated by from 55 to 68 seconds. Three minutes is necessary to bring the flywheel from rest up to full speed. When starting the direct voltage is reduced 15 to 18 volts. As the apparatus is connected to a power circuit, close regulation is not necessary.

O. H. Hutchings called attention to the saving in generating equipment by the use of this machine and the opportunity it affords to get business. At a similar installation in Detroit the line current was reduced in the ratio of 2.8 to 1. Since maximum-demand indicators require a duration of five minutes or more, he raised the question of what period of time should be considered in fixing the maximum demand. The flash demand cannot be used.

W. S. Culver considered such an outfit an advantage to both central station and consumer. The elimination of peaks has not been carried as far as possible, as the line peak is still usually about fifty per cent as high as the actual peak of load. The use of a Tirrill regulator permits more gradual change in converting motor to generator and hence a more constant load on the line. A shunt-wound set is not applicable except with automatic control. Direct use of alternating current is simpler to handle in this manner than direct current. The insertion of resistance in the circuit of a form-wound rotor enables the slit to be changed.

John C. Gilmartin told of another set in Toledo on a 500-volt direct-current circuit where the demand was reduced from 600 to 200 kilowatts.

J. T. Kermode stated that a peak of very short duration could not be determined accurately. In Cleveland they had fixed upon a fifteen-minute peak as suitable for basing charges. This would not apply, however, to such a case as considered in the paper.

A paper by G. A. Doeller on "Boulevard Lighting Systems" was then presented.

BOULEVARD LIGHTING SYSTEMS.

The festoon or arch system gives a good effect at night, but is ungainly during the day and maintenance is high. The ornamental post is to be preferred. Arc lamps give high efficiency and low maintenance, but first cost is high. Double systems are sometimes used. Schemes of development are considered and blank forms of contracts and agreements given. Good spacing for poles is eighty feet. Where no underground system exists, a shallow ditch can be dug near the curb and conduit or armored cable laid. Concrete poles are now the most common type, and should be of graceful design. Globes and sizes of lamp are discussed. Usually top lights burn all night and others until midnight, so that two circuits are desirable. Where erect globes are used, glassware should be washed every two months. Pendent globes collect dirt inside, and the additional downward illumination is greatly offset by increased cost of maintenance. Poles need to be painted only once a year. A table of costs, collected from different cities, is given. It is sometimes claimed that boulevard lighting results in cessation of window and sign lighting by many customers. The benefits of better street lighting are discussed.

G. H. Stickney spoke of the requirements for a fine appearance by night and by day. The latter is secured by a suitable design of post. Window lighting must be bright enough to attract attention after the people have been brought out by the street lighting.

W. S. Townsend, of Steubenville, stated that in the small towns where the cost of posts was prohibitive, his company had taken the workng parts out of arc lamps and replaced them by sockets and Mazda lamps. They were then mounted on trolley poles in pairs, one over the street and one over the sidewalk. They were also used in doorways and in front of windows. Renewals amounted to three per cent per year. For 100-watt lamps, $1.25 per month was charged.

D. L. Gaskill had found the consensus of opinion to be that it was safer to avoid private contracts for street

lighting. They were profitable when new, but usually resulted later in trouble.

J. T. Kenmode stated that in Cleveland only forty-two per cent of such bills could be collected.

W. C. Anderson said that a system must be uniform to be attractive, yet if free service were given where contracts had been terminated, it would constitute discrimination under the new utility law.

B. H. Gardner stated that in Dayton the city pays the entire bill and collects seven-eighths thereof from merchants by tax assessments. In some cases it is desirable to have it paid by inclusion in the rent. Street illumination detracts from window and sign lighting. In one town the loss on this account was three times the gain from street lighting.

T. D. Buckwell, of Toledo, had used magnetite lamps with reflectors, and found no bad effect upon the sign lighting. The city pays one-third the cost and the rest is assessed against the property owners.

C. S. Davidson spoke regarding the height of mounting and necessity for uniformity. The use of a lantern for park lighting had proved popular in Milwaukee and had been copied in New York City. Window lighting has generally been increased by intense street lighting. The reverse effect in Seattle was due to throwing the light up rather than down.

The report of the Committee on Motor Applications was then presented by B. H. Gardner.

REPORT ON MOTOR APPLICATIONS.

Attention is called to the new line of single-phase motors brought out by the Wagner Electric Manufacturing Company. The property of operating at approximately unity power-factor on loads from 75 to 130 per cent of full load makes this motor very attractive to the central station. Low power-factor may even be connected by one of these motors operating at 25 per cent load, as it then takes a leading current. The efficiency of this motor is high and the speed regulation good. The same company has also brought out a variable-speed alternating-current motor with characteristics similar to the shunt-wound direct-current motor. Demonstrations were made of these motors at the exhibit.

C. N. Jewett, of the Wagner Electric Manufacturing Company, answered some questions in regard to the new motors and explained some points not mentioned in the report, and the session then adjourned.

THURSDAY SESSION.

Vice-President Anderson called the meeting to order, and after the Finance Committee had made a report, a "Report on Insurance Rates Charged Electric Light Stations in Ohio" was presented by Secretary Gaskill.

INSURANCE RATES.

Central stations should be classed as a preferable risk, instead of extra hazardous, as proved by the statistics collected. Rates are very unequal for fire insurance, ranging from 0.8 to 4.0 per cent. In 1909, $16,411 was paid in premiums by sixty-one central stations, the policies covering $380,853 on buildings and $982,577 on machinery. The losses in five years amounted to only $60 from a single fire. Some stations also carry liability insurance and in five years these paid $29,595 in premiums, the losses being only $5,450. Many of the fire policies do not cover losses from fire caused by electric current, thus eliminating any increased risk which might otherwise be claimed to exist. The possibilties of organizing a mutual company were discussed. There are two ways in which this could be done, but the number of companies is hardly great enough to make it feasible. It should be possible to secure a different classification and lower rates from the existing insurance companies.

The best method of securing equitable rates was then discussed by Messrs. Townsend, Martin, Bechstein, Parsons, Hard and others. It was decided to appoint a standing committee on insurance.

A paper was then presented by B. H. Gardner on "Pumping Water for Municipalities and for Irrigation by Electricity."

ELECTRIC PUMPING.

One of the largest potential customers for electric power in this country, is our cities. Practically every city owns and operates its own water system, and in the operation of this system large amounts of power are used. Up to the present time very little has been accomplished by our central-station companies in securing this business. Of course the chief field for the possible use of electric power is in connection with the main city pumping stations for the supply of water for drinking, as well as other domestic purposes. This load offers a great many attractive features from the central-station man's point of view. There are two kinds of water-works systems in use in this country—one a direct system, where no reservoir capacity is provided, the rate of pumping water varying directly as the demand for water; and the reservoir system, where a reservoir is provided, so that water may be supplied after the pumps are shut down. Of the two systems, the most attractive and the easiest to get on a profitable basis, is, of course, the reservoir system. With such a system the pumping can be very largely done at such times as best suit the load conditions of the central station, and so can be made off-peak business. In a direct system the greatest demands for water are during the months from April to October, when the demand for electric current is least. There is thus a diversity-factor offered. Practically all new systems being installed have the reservoir feature. For the direct systems that are already installed, probably the best method of securing this business is by advocating a combined station, the old steam equipment to operate during peak months, and motor-driven pumps to carry the summer load. There are many other uses for electric power by municipalities in connection with garbage disposal, high-pressure systems for fire purposes, stations used for pumping in case of high water, etc. The Northern Colorado Power Company has developed during the last two years sufficient irrigation-pumping load to make its kilowatt-hours output during the summer exceed that of the winter months, but the daily peak was not as high as in the winter. In these two factors lie the great value of irrigation pumping. There are some who think our own farmers will soon use irrigation, because the increased production of the land will much more than pay for the cost of the irrigation. When irrigation does come our power load should be greatly increased. The ease and economy with which electricity can be transmitted over wide areas and used to drive motors make electric pumping preferable to the gravity system of irrigation in many ways. The pumps can be in comparatively small units, each supplying a local area. The distributing ditches are small, thus leaving maximum area for crops, and the water supply to each area is always under perfect control. There is minimum danger of broken ditches and flooded crops such as sometimes occur with large ditches. The quantity of water needed for irrigation varies. An average of eight acre-inches per month during the irrigation season is considered ample in most cases. The delivery of this quantity to the distributing ditches can be made in installments; for some crops these installments can be limited to two or three, while for others they must be much more frequent. The irrigation season usually lasts about three months for each crop. Tests made by the United States Government indicate that where the water does not have to be lifted more than twenty-five feet and where the price for current is three cents (0.03) per kilowatt-hour, the cost of irrigation will not be more than $3.00 per acre-foot, two acre-feet being about the quantity of water needed per year. To those of our companies who are so situated that water may be easily obtained, it seems that irrigation offers an excellent opportunity to improve the central-stations load-factor and raise their income.

This paper was discussed by Messrs. Graves, Smith, Gates, Gardner, Townsend, Martin, Culver, Hard, Stewart, and others. It was brought out that in some towns the insurance rate was higher with electric pumping on grounds of reliability. This is dependent upon whether a standpipe or reservoir is used.

J. T. Kermode said that a duplicate feeders to fire-pumps had been required in Cleveland.

W. C. Anderson stated that present conditions are due to the history of development of the central station. Fire-insurance companies are conservative and base their demands upon past conditions. Steam pumping is more satisfactory where the units are large. The field for electric pumping lies with small units. Insurance rates are higher for gasoline pumping as well as for electric.

D. L. Gaskill said that no small company should undertake city pumping

without a reservoir. Insurance people are not only conservative but unreasonable and attribute many fires to electric origins which are not so caused.

W. S. Culver called attention to the fact that continuity is most likely to be interrupted at the very time that fires are most dangerous, namely in high winds. Continuity depends more on the transmission system than upon the generating plant.

B. H. Gardner, answering a question, stated that centrifugal pumps had a good efficiency at full load, though in small sizes not quite as good as reciprocating pumps, but when working at low loads the efficiency is very low.

The report of the Committee on Meters was then presented by John G. Gilmartin.

REPORT ON METERS.

The topics reported on are: Importance of meter testing, proper test intervals, tabulating results, definition of average accuracy, accuracy data, meter jewels, excess indicators. An exhibit of testing equipment, protective devices and forms was made by the committee in the exhibit hall. Meters should be calibrated in the shop, but should also be tested after installation. Vibration, moisture, stray fields, temperature, short-circuits, differences in voltage and wave form may all affect accuracy. The natural tendency is to run slow, but under some circumstances meters will run fast. A rotating standard is the best instrument for testing. Where inconvenient to test with customer's load, phantom load boxes can be used. The cost of testing varies greatly with conditions, but does not average more than 50 to 75 cents. Considering the losses due to slow meters, testing is really a source of revenue to the company. A table is given of recommended test intervals, varying from 2 to 12 months. Results should be tabulated and averaged, giving data in cases of controversy, showing how much revenue is being lost by slow meters, and how best to spend money for testing. Groupings for averaging are recommended. The rules of the N. E. L. A. for average accuracy and normal load are recommended. Results of tests are given showing the effect of worn jewels on accuracy and the difference in life of sapphire and diamond jewels. The latter are recommended for all copper-disk commutator meters except where the revenue is less than $15 per year. After 200,000 shaft turns ten per cent of the sapphires were defective and none of the diamonds; after 1,000,000 turns seventy per cent of the sapphires were defective and only four per cent of the diamonds. Diamond jewels are not necessary in induction meters. Excess-demand indicators give satisfactory results in general, but if a large overload is connected, such as a 500-watt iron on a 100-watt circuit, vibration is so rapid that sufficient current to heat the iron will flow. If installed out doors the oil may congeal in cold weather. The voltage drop in some indicators is too high. Meter protective devices can now be obtained including special meter-testing cutouts. These obviate interruption of service.

This report was adversely criticized by W. L. Cook, who commended the work of the Committee, but disagreed with the conclusions regarding testing on premises. The testing laboratory should have a suitable location and meters should be tested there. The cost is approximately the same. He thought the tabulation of results misleading, and did not advise publication of them. Diamond jewels are more necessary in business districts. His company checks the bills by plotting a consumption curve.

G. R. Smith advocated testing on premises as cheaper and impressing customers more favorably.

R. S. Graves also advocated testing on premises.

In closing, J. G. Gilmartin referred to last year's report, which showed that meters tested soon after installation show a lower percentage reading than results from an additional six months in use.

D. L. Gaskill then read a paper on "The Utility Law of Ohio and Its Application to Electric Lighting Companies."

UTILITY LAW OF OHIO.

This paper describes the efforts made over eleven years ago by the Ohio Electric Light Association to draft a reasonable public-utility bill. Unfortunately at that time the public was not awake to the necessity for the proper form of legislature and within recent years the enactment of a public-utility law and the appointment of a commission had been seized upon by politicians as a political asset. This has made possible the passage of an act, which, while not entirely unsatisfactory, should be the subject of considerable change before it can properly perform its function as a regulation and protection for the public and the public-service corporation.

FRIDAY SESSION.

The session on Friday opened with the report of the Nominating Committee, which was accepted, and the secretary instructed to cast the ballot of the society. The following officers and committees were elected:

President, W. C. Anderson.

Vice-President, J. C. Martin.

Secretary, D. L. Gaskill.

Executive Committee: E. H. Beil, W. S. Townsend, W. E. Richards, O. H. Hutchings and L. G. White.

Advisory Board: Samuel Scovil, F. M. Tait and D. L. Gaskill.

Finance Committee: J. T. Kermode, F. O. Plymale and B. H. Gardner.

Publicity Committee: W. P. Engel, C. M. Lott, Elam Fisher and R. N. Hodson.

Electric Transmission: W. S. Townsend, J. T. Kermode and M. H. Wagner.

Membership Committee: W. J. Hanley, E. Van Winkle, P. J. Williams, F. C. Colwell, N. C. Cotabish, W. F. Benedict and George Vail.

Committee on Meters: John G. Gilmartin, W. L. Cook and J. T. Kermode.

Committee on Insurance: D. L. Gaskill, J. C. Martin and C. V. Hood.

Committee on Motor Applications: E. A. Bechstein, C. J. Crippen and W. F. Hubbard.

The salary of the secretary for the ensuing year was fixed at $1,500. The first paper of this session was by W. C. Anderson on "Motor-Driven Refrigeration."

MOTOR-DRIVEN REFRIGERATION.

No other form of power procurable can compete with the electric motor in the field of small refrigerating plants. So plain is this that some manufacturers of small refrigerating plants will not sell their apparatus except for motor drive, fearing that the irritation due to power troubles will more than offset the good features of the outfit and tend to retard the sale of the apparatus. The power required by a refrigerating plant depends very largely upon the excellence of its design and manufacture, also upon the temperature and quantity of cooling water and where good cold well water can be had for the pumping, a motor-driven pump and a well is likely to prove a valuable adjunct.

The automatic refrigerating plant is a comparatively late development but one of very great promise and with the well known simplicity, reliability and adaptability to automatic control of the electric motor the future seems to hold very great possibilities in automatic refrigerating plants. There are ten refrigerating plants connected to the lines of the Canton Electric Company, some of which have been in operation for eight or nine years and all of them have operated with satisfaction. The table gives the power consumption in kilowatt-hours of six of these plants which were metered in such a manner as to give results of value for purposes of comparison:

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
January	146	646	1,950	.....	51	516
February	70	733	2,210	.....	34	120
March	112	846	2,070	286	102	892
April	322	1,627	2,600	1,528	1,240	2,168
May	247	1,654	2,850	1,622	1,139	1,928
June	403	2,826	3,600	2,050	1,069	1,976
July	343	4,718	6,040	2,062	2,649	1,978
August	540	5,633	5,590	2,060	2,518	2,212
September	591	4,174	4,790	1,712	2,100	2,200
October	576	2,145	4,200	1,476	1,639	2,052
November	453	1,161	2,630	804	944	1,540
December	335	229	3,310	.....	936	264
Motor H. P.	7.5	10	20	7.5	26	16
Tons refrigeration	3	3	5	3	5	3

The power demand of a refrigerating plant naturally evades the lighting peak so that with comparatively little trouble all the refrigerating load can be made off-peak business.

This paper was discussed by Messrs. Gaskill, Culver, Martin, Crippen, Rust, Townsend, Taylor, Anderson and others. It was shown that this form of load is very desirable to the central station and that the results are very advantageous to butchers and others. A special advantage to the butchers is due to the saving of the waste which is incurred in ice boxes due to the blackening of the meat, about eight per cent of which has to be trimmed

away every day. Many of these customers can be secured on contracts for limited service, which limits them to an off-peak load. One hotel keeper in Norwalk who had been converted from gasoline operation was particularly pleased.

The next paper was by W. B. Goudy on "The Use of Tungsten Lamps in Sign and Outline Lighting."

TUNGSTEN FOR STREET LIGHTING.

The author believes that the low-voltage tungsten sign lamp has placed the electric sign within the reach of all in so far as operating costs are concerned. Not only has it reduced the expense of operation, but it has resulted in a marked improvement in the quality of light produced. The paper analyzes the possible profits through the use of the tungsten sign lamp and discusses the question of the advisability of series and parallel wiring of the signs.

G. H. Stickney opened the discussion by calling attention to the reduction in cost by the use of tungsten lamps, which are more important in their results here than in any other field. Very often too large lamps are selected, especially in outline lighting. With tungsten lamps it is much easier to select an appropriate unit. Under proper conditions the maintenance is not necessarily high. He stated that the selection and sorting of lamps for series operation had been much improved and in the future it is not to be expected that the same trouble will be experienced as has been had in the past.

Mr. Benedict stated that he had found 2.5-watt lamps very satisfactory and preferable to the low-candlepower carbon lamps.

J. T. Kermode had found a series connection preferable on direct-current circuits and did not advise the use of multiple-series connection. If multiple circuits were necessary he preferred to use carbon lamps.

W. C. Anderson found that on series circuits it is very desirable to use lamps at less than their nominal voltage rating. Operation is then satisfactory on a straight series circuit.

Messrs. Crippen, Rust and Reemelin also joined in the discussion. The latter had found series operation preferable to multiple-series.

The secretary then made some announcements and a discussion ensued on the question of filling rates and determining costs of production. It was decided to appoint a Committee on Costs to consist of M. E. Turner, B. H. Gardner and J. D. Lyons. A motion was also passed directing the secretary to compile and distribute copies of the rates which are required to be filed with the Public Utility Commission, duplicate copies of which are to be sent by all central stations to the secretary. The last paper of the session was one by P. L. Miles on "The Progress of Electric Heating Devices in Ohio." In the absence of the author this was read by the secretary and the meeting then adjourned.

ELECTRIC HEATING DEVICES.

Mr. Miles' paper gives a summary of data relative to the progress of electric heating devices in Ohio obtained from central-station companies in various typical cities selected. Information regarding six of these is tabulated, the populations of the towns ranging from 2,000 to 120,000 inhabitants. The data describes the nature of the advertising, if any, carried on for the development of electric heating devices, any special features of development methods, and gives the rate charged for heating current. Referring to electric cooking, Mr. Miles paid special attention to the campaign carried on in Cleveland and described an electric range known as the Cleveland range which was manufactured especially for the Cleveland company and has met with general favor in that city. In general appearance the Cleveland range is similar to an ordinary gas or coal range; oven at the bottom; broiler at top of the oven, and four heating plates —two in front and two in rear corresponding to the burners on a gas range. The warming closet is placed above the top surface, and on each side of the oven just below the top surface are the switches controlling the various heating units. The principal feature is the fireless cooker compartment or oven. Mr. Miles explained that 100 of these ranges have been installed and that they are as successful in all their cooking operations as any range using other forms of fuel.

EXHIBITS.

Acme Electric Heater Company, Detroit, Mich., exhibited sad-irons. William H. Hausen was in charge.

Adams-Bagnall Electric Company, Cleveland, O., exhibited fans, flaming-arc lamps, ABolite tungsten fixtures, etc. D. H. Kelly and W. G. Rowland were in attendance.

Allis-Chalmers Company, Milwaukee, Wis., exhibited a model of a section through a turbine, also a motor and transformer. F. S. Sly, F. C. Colwell, E. T. Pardee, William Wray and S. Wolff were in attendance.

American Electrical Heater Company, Detroit, Mich., exhibited toasters and irons. James Strasburg was in charge.

Canton Electric Sign Company, Canton, O., exhibited electric signs.

Comet Electric Stove Company, Detroit, Mich., exhibited electric stoves, frying pans and fireless cookers. E. J. Mamer and James D. Lamont were in attendance and Mrs. Lamont gave demonstrations.

Crocker-Wheeler Company, Ampere, N. J., exhibited a polyphase motor, transformer and parts.

Dover Manufacturing Company, Canal Dover, O., exhibited A-Best-O irons with automatic heat control. George C. King was in charge.

Eclipse Electric Manufacturing Company, Chicago, Ill., exhibited flat-rate controllers and motorless flashers. F. C. Kirchhoff was in charge.

Electric Power Maintenance Company, Toledo, O., distributed "baby-coil" souvenirs.

Enterprise Electric Company, Warren, O., exhibited Peerless transformers. F. P. McBerty was the representative.

F. Bissell Company, Toledo, O., exhibited motors, including a sewing-machine motor, switchboard panels, etc. E. R. Gillet and others were in attendance.

Fort Wayne Electric Works of the General Electric Company exhibited fans, motors, Premier vacuum cleaners, compensare, meters and transformers. Messrs. Edgar and William Orr were in attendance.

General Electric Company, Schenectady, N. Y., exhibited meters, ozonizer, steam-flow meter, luminous radiator, electric range and other heating devices. Among those in attendance were J. B. Pevear, N. C. Ross, W. S. Culver, W. J. Hanley and H. C. Houck.

Hart Manufacturing Company, Hartford, Conn., exhibited protective devices and specialties.

Hoover Suction Sweeper Company, New Berlin, O., exhibited suction sweepers. W W. Steele and O. F. Binford were in attendance.

Hughes Electric Heating Company, Chicago, Ill., exhibited stoves, toasters and an electric range. George A. Hughes represented the company.

Hurley Washing Machine Company, Chicago, Ill., exhibited the Thor washer. C. B. Brown was in charge.

Machado & Roller, New York, N. Y., exhibited instruments, circuit-breakers and meters. George L. Crosby, W. H. Sinks and F. M. Pingrey were in attendance.

Mica Electric Sign Company, Cincinnati, O., exhibited electric signs. Hugh Mulholland was the representative.

Kimball Electric Company, Chicago, Ill., exhibited a blower and variable-speed motor. R. P. Warner was the representative.

Northwestern Electric Equipment Company, Brooklyn, N. Y., exhibited Metropolitan protective devices such as meter seals, cut-outs, etc., in conjunction with the Meter Committee. George R. Smith was in charge.

Packard Electric Company, Warren, O., exhibited transformer specialties, insulating materials and the A-W Mazda series regulator. N. A. Wolcott, A. B. Weeks and W. C. Woodland were in attendance.

Sangamo Electric Company, Springfield, Ill., exhibited Sangamo meters and instruments. F. J. Alderson was the representative.

Sterling Electrical Manufacturing Company, Warren, O., exhibited drawn-wire Mazda lamps for street illumination. W. F. Benedict, J. T. Donahue and H. M. Boyle were in attendance.

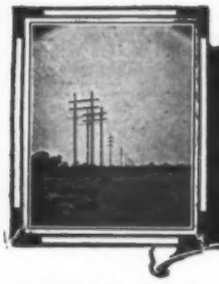
Thompson Brothers, Cincinnati, O., exhibited the Perfect electric washer. J. C. Thompson was in charge.

Wagner Electric Manufacturing Company, St. Louis, Mo., exhibited the new type BK single-phase motor with unity power-factor, the old type BA single-phase motor with switchboard and a mechanical rectifier. F. N. Jewett, P. B. Postlethwaite and A. B. Hollman were in attendance.

Western Electric Company, Chicago, Ill., exhibited the Jewel washing machine, lamps, the Quad fireless cooker and other cooking and heating devices. A. Schwencke, L. T. Milner, E. M. Maclean, Hans Owens and others were in attendance.

Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., exhibited motors, fans tungsten lamps, mercury rectifier, meters, circuit-breakers, heating and cooking devices and a section through a transformer. J. C. McQuiston, W. Barnes, Jr., and others were in attendance.

W. N. Matthews & Brother, St. Louis, Mo, exhibited a boltless guy clamp, a combined fuse and switch box, guy anchors, etc. W. E. Bischoff was in charge.



CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

DEVELOPMENTS IN STEAM-CONDENSING EQUIPMENT.

BY SYDNEY F. WALKER.

The advent of the steam turbine, and its establishment as a thoroughly practical apparatus, has brought about a revolution in condensing equipment, not only for turbines, but for reciprocating engines also. Before the advent of the steam turbine, it was a canon of reciprocating steam-engine practice that it was not economical to employ a vacuum above twenty-five inches of mercury; the saving in steam arising from the higher vacua was more than neutralized by the increased cost in fuel for pumping the circulating water.

Bearing upon this subject, Richard Allen, of W. H. Allen & Sons, of Bedford, England, made a very interesting series of experiments a few years back, to determine the increased quantity of water required with increased vacua. The quantity of cooling water required, of course, varies with the extent of the cooling surface. With a cooling surface dealing with five pounds of steam per square foot, and with cooling water at an initial temperature of sixty-five degrees Fahrenheit a 26.75-inch vacuum was obtained in Mr. Allen's experiments for 26 pounds of water per pound of steam condensed. With a 27.25-inch vacuum, the cooling water rose to 40 pounds per pound of steam, or about four gallons; at 27.5 inches of vacuum, the cooling water was 45 pounds; at 27.75 inches of vacuum, 50 pounds, and so on. With cooling water at higher temperatures, the increase in the quantity of water required was even more marked. In later experiments, better results were obtained.

In addition to this, reciprocating-steam engineers held that, in a great many cases at any rate, it was not economical to employ high vacua, because the condensed-steam water produced, which was generally employed as feed water for the boiler, was so much lower in temperature. On shore, where economizers are employed, this argument is, of course, of no value, since the heat from the flue gases will make good all and more than all the temperature that is lost by a high vacuum in the condenser. On board ship, however, for which economizers have not so far been adapted, the effect of the low temperature of the feed water was felt. There, however, recent practice has shown that the steam from the auxiliary engines, if passed directly into the feed water, consisting of the condensed steam from the main engines, is quite sufficient to raise the temperature to within measurable distance of that in the boiler itself.

As is well known, the economy of working in the steam turbine is largely due to the fact that the lower steam temperatures obtained with higher vacua can be used. Another difficulty which reciprocating-steam engineers complain of, in using very low-pressure steam is the fact that their low-pressure engines would have to be of very much larger sectional area, in order to deal with the much larger volume of steam. The steam turbine has, of course, no difficulty whatever in dealing with the largest volumes of steam that can be produced by high vacua, nor in dealing with the low temperatures. There was, however, a great difficulty at first in producing high vacua, and it seemed at one time as if the development of the steam turbine was to be arrested owing to that difficulty.

As in so many other cases where the steam turbine has been to the fore, Sir Charles Parsons, as he now is, the Hon. Charles Parsons he was then, was in the lead in meeting the difficulty. Quite early in the period over which the development of the steam turbine has extended, he introduced his vacuum augmenter, by which he claims that every inch of vacuum above twenty-five inches produces an economy in steam consumption of one per cent and therefore a similar economy in the fuel bill.

Other inventors have also entered the field, among them being the inventors of the "Contraflo" condenser. In the Contraflo condenser, the problem is attacked in a somewhat different manner to that adopted by Sir Charles Parsons. In the Parsons vacuum augmenter, there is an auxiliary condenser worked by an ingenious application of the injector principle. The augmenter condenser draws off the air and vapor from the lower part of the main condenser, the auxiliary condenser discharging into the same pipe as the main condenser, the whole of the vapor, air and water being withdrawn together by the air pump.

In the "Contraflo" condenser, various devices are employed to divide up the process of condensing. One of the principal difficulties in the working of surface condensers is the fact that vapor is reformed from the water that has already been condensed, when the vacuum reaches a certain figure. To prevent this, in the Contraflo condenser the water is drawn off immediately it is formed. Further, arrangements are made for trapping the water, at various points of the condenser, and withdrawing it, and for driving the air through small apertures, so that its density shall be increased.

This condenser is also claimed to have been very successful and to have enabled vacua of 28.5 inches to be obtained with marine engines in the tropics.

Marine engineers, previously to the advance in the working of condensers, had settled down not only to the maximum vacuum of 25 inches, but to something like 20 to 21.5 inches in the tropics, when the cooling water obtainable was at a high temperature. With the Contraflo condenser, vacua of 27.5 inches have been obtained with circulating water at an inlet temperature of seventy-four degrees.

It has been shown also by some careful experiments on shore that high vacua can be obtained with the ordi-

nary surface condenser and that economies follow. In some very interesting experiments that were made by Messrs. Belliss & Morcom, of Birmingham, who have been to the front in the manufacture of high-speed engines (their system of forced lubrication having solved the problem of the double-acting high-speed reciprocating engine some years ago), upon a triple-expansion engine, it was found that a vacuum of 27.9 inches could easily be obtained, and with a saving of 1.77 per cent in the steam consumption of the engine was obtained for each inch increase in the condenser vacuum.

Various causes go to produce this result. One is a better understanding of the general problem and of the manner in which the production of the vacuum affects the working of the engine, than was obtained before the advent of the steam turbine. It is now thoroughly well understood that a vacuum in the condenser, however high, is of no value unless it can be carried right back to the low-pressure cylinder. In some of the earlier engines of the old type, before the problem was studied as it has been recently, the exhaust ports were so proportioned, and the path of the steam to the condenser was of such a nature, that the full benefit of the vacuum was not obtained in the engine. It will be remembered, of course, that the object of obtaining a vacuum in the low-pressure cylinder, or in any cylinder, is to reduce the work which the piston has to perform on its return stroke. In a great number of engines, whether working with condensers or exhausting to the atmosphere, there is a certain amount of pressure in the steam, over and above that due to the atmosphere or to the vacuum in the condenser, which the piston has to overcome as it moves forward under the pressure of the incoming steam. The mean back pressure goes to reduce the mean effective pressure, and therefore anything which can reduce the back pressure increases the efficiency of the engine.

In Messrs. Belliss & Morcom's experiments, some very interesting results were obtained. Thus, the work done in the low-pressure cylinder was reduced, and that in the high-pressure cylinder increased; at the same time the cut-off in the high-pressure cylinder was also reduced. With a vacuum of 21.5 inches at the engine, the cut-off was 0.45; while with a vacuum of 27.9 inches, the cut-off was 0.4. The consumption of steam with the 21.5-inch vacuum was 14.6 pounds per brake horsepower per hour, and with a 27.9-inch vacuum, 12.7 pounds per brake horsepower per hour. As the engine upon which the experiments were made furnished 1,100 brake horsepower, the test was by no means a laboratory trial; it was a thoroughly practical test.

Another cause of the advance that has been made, is the improvements in air pumps. Air pumps are now upon the market, which draw off the air from the condenser, apart from the condensed water. Other pumps have been introduced, notably the Le Blanc, working upon entirely new lines, by means of which practically any vacuum that may be desired is obtainable. In the Le Blanc pump, what is practically a Pelton water wheel is employed to extract the air from the condenser. The water wheel itself works upon a closed water circuit, the water going through the wheel, and returning to its source, and through the wheel again, and so on. The air is drawn out of the condenser by the injector action of the flowing water, and the result is stated to be very satisfactory indeed, vacua as high as 29.31 inches having been obtained in special cases.

A point that may be noted in connection with condenser work is the ability of the water to dissolve air. Water has the property of dissolving all gases, and the ability increases as the temperature of the water decreases. Hence, dividing up the water, carrying off the condensed water immediately it is formed, and before it has time to cool, tends to lessen the quantity of air that is dissolved in it. The solution of air in the water has a double effect, both actions tending to lower the efficiency of the condenser. In dissolving in water, any gas, it is claimed by modern physicists, assumes the liquid state, giving up the heat of its gaseous condition to the liquid in which it is dissolved, and thereby raising its temperature. Hence allowing the water to remain in the condenser, and to become cooled to a certain extent, allows also the air which is being continually brought over from the engines to be dissolved in it, to raise its temperature, to cause reformation of water vapor, and so on.

All of those points have been successfully grappled with during the last ten years or so, which correspond with the application of the turbine to marine work. It is since Sir Charles Parsons showed that the steam turbine was applicable to driving the propellers of steamships, that it has made more rapid headway than before; and it is during this period that condenser makers and the makers of condenser auxiliaries have grappled with the different parts of the problem, in the manner described. The net result of the whole thing is that high vacua are now obtainable for both reciprocating engines and turbines, and the reciprocating engine is able to put up a better fight against the steam turbine than it could have done if the condenser had not been improved.

Specification for Fuel Oil.

In consequence of the success that has attended the use of heating-value specifications in buying and selling coal there has arisen a demand for similar specifications, based on careful tests, to govern the purchase of fuel oils and the refined products of petroleum. The United States Bureau of Mines has therefore issued Technical Paper No. 3, by Irving C. Allen, on "Specifications for the Purchase of Fuel Oil for the Government," which also contains directions for sampling oil and natural gas. Copies of this paper may be obtained from the Director of the Bureau of Mines, Washington, D. C.

"These specifications, to be satisfactory," says the author, "should establish not only the heating value of the oil, and thus show, like the specifications for coal, the number of heat units the purchaser obtains for a given price per unit quantity of fuel, but also the physical character of the oil, its flash-point and burning-point, and the quantity of extraneous matter it contains. It is evident that an essential feature of any such plan of purchasing oil in bulk is an equitable method of sampling deliveries, that is, a method that insures the taking of representative samples. The Bureau of Mines has received many inquiries from Government bureaus and from private concerns regarding fuel-oil specifications and the sampling of purchases. In reply to these inquiries the Bureau issues this paper, which, although intended primarily for the guidance of Government officials, may be of service, the Bureau trusts, to all persons who buy or sell fuel oil."

General specifications for the purchase of fuel oil are given as follows:

In determining the award of a contract, consideration will be given to the quality of the fuel offered by the bidders, as well

as the price, and should it appear to be to the best interest of the Government to award a contract at a higher price than that named in the lowest bid or bids received, the contract will be so awarded.

Fuel oil should be either a natural homogeneous oil or a homogeneous residue from a natural oil; if the latter, all constituents having a low flash-point should have been removed by distillation; it should not be composed of a light oil and a heavy residue mixed in such proportions as to give the density desired.

It should not have been distilled at a temperature high enough to burn it, nor at a temperature so high that flecks of carbonaceous matter began to separate.

It should not flash below 60°C. (140°F.) in a closed Abel-Pensky or Pensky-Martens tester.

Its specific gravity should range from 0.85 to 0.96 at 15°C. (59°F.); the oil should be rejected if its specific gravity is above 0.97 at that temperature.

It should be mobile, free from solid or semisolid bodies, and should flow readily, at ordinary atmospheric temperatures and under a head of one foot of oil, through a four-inch pipe ten feet in length.

It should not congeal nor become too sluggish to flow at 0°C. (32°F.).

It should have a calorific value of not less than 10,000 calories per gram (18,000 British thermal units per pound); 10,250 calories to be the standard. A bonus is to be paid or a penalty deducted according to the method stated under section 21, as the fuel oil delivered is above or below this standard.

It should be rejected if it contains more than two per cent water.

It should be rejected if it contains more than one per cent sulphur.

It should not contain more than a trace of sand, clay, or dirt.

Each bidder must submit an accurate statement regarding the fuel oil he proposes to furnish. This statement should show: the commercial name of the oil; the name or designation of the field from which the oil is obtained; whether the oil is a crude oil, a refinery residue, or a distillate; the name and location of the refinery, if the oil has been refined at all.

The fuel oil is to be delivered f. o. b. cars or vessels, according to the manner of shipment, at such places, at such times, and in such quantities as may be required, during the fiscal year ending ———.

Should the contractor, for any reason, fail to comply with a written order to make delivery, the Government is to be at liberty to buy oil in the open market and charge against the contractor any excess of price, above the contract price, of the fuel oil so purchased.

The Lagging of Pipes and Wires.

The effect of providing a wire or pipe with a lagging for the purpose of preventing heat losses is still imperfectly understood. Most people probably assume that the lagged pipe will always be warmer than the bare pipe. But A. W. Porter showed two years ago, in the London Physical Society, that a coat of a poor thermal conductor might actually keep a pipe cooler than it would be without that coat.

In a simple demonstration such as Professor Porter gave a few weeks ago at the Royal Society soirée, a platinum wire is coated at intervals with a thin layer of glass, which is easily fused round the wire, which thus appears as if covered with cylindrical glass beads. When the wire is heated by the electric current, it glows very brightly in the bare portions, while the covered portions remain dark and several hundred degrees cooler. The coating is heated from inside, and loses heat by radiation on the outside; its temperature will, therefore, depend upon the ratio of its thermal conductivity k to its emissivity e, and the thickness of the coating will enter into the problem. As long as the outer radius of the lagging exceeds a certain critical value depending upon k/e, the temperature on the inside of the sheath of the wire will increase, and the sheath will act as a lagging; but when the outer radius is less than this critical value, the wire will lose more heat than it would if bare. This critical value should, as such, be independent of the radius of the wire.

Professor Porter calculated the following values for the critical radius, expressed in centimeters: crown glass, 8; slate, 16; shellac, 2; rubber, 1.3; gutta-percha, 1.5; paper, 1.0; asbestos paper, 1.9; cork, 0.4; silk, 0.7; flannel, 0.8; cotton, 1.8; and calcined magnesia, 0.5. Thus a coating of glass, up to 8 centimeters in thickness, on a fine wire would actually be detrimental for maintaining a high temperature. A lagging of the thickness of the neutral radius should have no lagging effect at all, while, a still thicker coating should prevent radiation losses of heat. This neutral radius decreases as the wire thickness increases. Thus, for a wire of 0.25 centimeter radius the neutral radius for a lagging of Para rubber is 10 centimeters whilst for a wire of 0.50 centimeter radius the neutral radius is 2.9 centimeters. In practice, other considerations—for instance, the changes of the electric resistance and of the emissivity with temperature—would complicate the phenomena, and reduce the temperature differences between the covered and the uncovered portions.

With respect to the lagging of steam-pipes, and the condensation of steam in them, Professor Porter made a few experiments in conjunction with E. R. Martin. They joined two brass pipes, 0.19 centimeter in diameter, to a steam-trap and collected the issuing water. One of the steam-pipes was provided with one coating of asbestos paper, the other with several coatings; the two surfaces were thus of the same kind, but the coatings of different thicknesses. The emissivity and the thermal conductivity of the asbestos paper were determined, and the critical radius deduced was 0.527 centimeter. From the actual condensation experiments the value 0.57 centimeter would have been expected; this is a fair agreement, which was also shown by the theoretical and the observed curves. Thus it would result that on small-bore steam-pipes, adding asbestos lagging so as to bring the outer radius up to half a centimeter in external radius actually encourages the escape of heat, and it is interesting to note that the loss of heat would appear to be the same for external radii of 0.24 and of 2 centimeters. These small radii are hardly engineering dimensions, but they are not too small for the laboratory and for experimental apparatus generally. The properties of bad thermal conductors require further study, and engineers would welcome the results of full-sized experiments designed to test the practical aspects of Professor Porter's scientific investigation.—*Engineering.*

Lignite Briquets.

The results of the investigations on the briquetting of lignite by the Bureau of Mines show that some American lignites equal German lignites in fuel value and can probably be made into briquets on a commercial scale without the use of binding materials. Cohesion and weathering tests demonstrated that good briquets endure handling and resist weathering much better than the lignite from which they are made.

The tests described show that the cost of briquetting run-of-mine lignites with a German plant, which was used, would be from $1.35 to $1.75 per ton, according to the location of the plant. The cost per ton of briquets, loaded on cars, from a briquet plant at the mine would be, in Texas, $2.51; in North Dakota, $3.53; and in California, $5.24. These figures are subject to wide changes because of local conditions. They apply to briquetting run-of-mine lignite to improve its heat value and weather-resisting properties, rather than to briquetting slack or waste coal.

Of four samples of raw lignite, three samples contained about forty per cent of moisture and had a fuel value of 6,079 to 6,241 British thermal units, while a Texas lignite, with a moisture content of thirty-three per cent had a fuel value of 6,840 units. The percentage of moisture removed in the process

of briquetting ranged from 24 to 32 per cent and the heat value of the briquet was 36.5 to 54 per cent higher than that of the raw lignites.

Excessive moisture in fuel not only causes a waste of useful heat during combustion, because the moisture is vaporized and the vapor superheated, but also is a source of expense to the consumer, who pays freight charges on useless water. For both these reasons lignite briquets have the advantage over raw lignite. In the case of one of the North Dakota lignites the removal of thirty-two per cent of moisture during briquetting permits a decided lessening of the cost of supplying a consumer with a given number of heat units. The advantage of the briquets in this respect is of special importance when transportation to a distant market is involved. If the briquets possess no other advantage over raw lignite than their higher heat value, they would be worth fifty per cent more than the raw fuel.

Examination for Electrical Engineer and Draftsman.

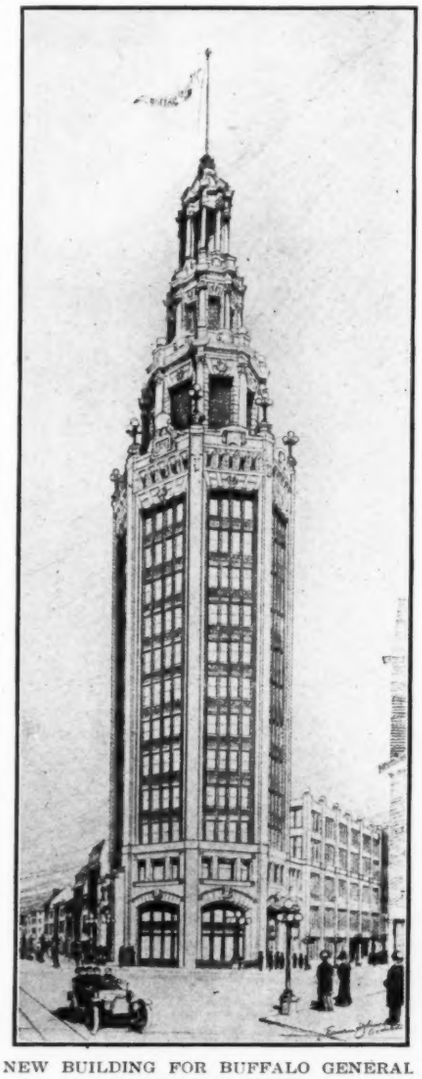
The United States Civil Service Commission announces an examination on August 23 to 25, 1911, at the usual places, to secure eligibles from which to make certification to fill a vacancy in the position of electrical engineer and draftsman at $1,200 per annum, in the office of the Supervising Architect of the Treasury Department, Washington, D. C., and vacancies requiring similar qualifications as they may occur.

Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of any local board of examiners for application and examination Form 1312.

New Building for the Buffalo General Electric Company.

The contract for the construction of the new building for the Buffalo General Electric Company was recently let to John Gill & Company, of Cleveland, O. The work of erecting this building is now under way, and it will be ready for occupancy by May 1, 1912.

The building will be located at the intersection of Genesee, Washington and Huron Streets. It will be 300 feet in height, and will be the tallest building in the city of Buffalo. The lower portion will be of granite, with the upper stories of brick and terra cotta. The first two floors, covering the entire site, will be occupied by the Buffalo General Electric Company, and the third floor by the Cataract Power & Conduit Company. The upper floors in the tower will be rented for office purposes. The interior finish will be of mahogany. On the first two floors of the building will be located the general



NEW BUILDING FOR BUFFALO GENERAL ELECTRIC COMPANY.

offices of the Buffalo General Electric Company, contract department, construction department, meter department, etc. In the basement there will be a large display room. A rotary-converter substation and a large storage battery will also be located in the basement. The top floor of the building will be used for an assembly room for employees of the Company.

The plans for the illumination of the building are in the hands of W. D'A. Ryan, illuminating engineer of the General Electric Company, Schnectady, N. Y.

Comments on the Preservation of Pole Timbers.

The United States Forest Service has recently issued Bulletin No. 84, which is devoted to the preservative treatment of poles. Present knowledge of the results of the creosote treatment of wooden poles is based largely on treatments made by the pressure method, using from eight to twelve pounds, or more, of creosote to a cubic foot of timber. The expense incident to such treatment has been the chief hindrance to its more general adoption for poles. Investigations of the Forest Service have therefore been concerned with treatments which could be applied locally without the erection of elaborate and extensive plants. Much attention has also been given to the seasoning of poles, since proper seasoning not only prepares poles to receive the preservative, but under certain conditions may be in itself a means of increasing their durability.

Seasoning of poles reduces their weight usually from sixteen to thirty per cent, and even more for some species. In general, poles cut during the spring and summer lose weight most rapidly; those cut during the autumn and winter lose less rapidly, but more regularly.

Preservative applied to the surface of a pole by a brush may add from one to two years to the life of timber, but permanent protection should not be expected from the application of so small a quantity of preservative. If the butt be more deeply impregnated, the life of the pole will probably be limited by the life of the top rather than by that of the butt. A life of twenty years for butt-treated chestnut and western cedar, and twenty-two years for northern white cedar poles is believed to be a conservative estimate. In the drier western climate butt-treated pine poles can probably be depended on to give twenty years' service.

Impregnation of many pole timbers may be accomplished in open tanks, without the use of artificial pressure, by immersion in hot and cold preservatives, the cold following the hot. The open-tank process has the advantage that it is possible to apply the preservative to the butts only, with a great saving in the creosote.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

Electric Lighting of a Canadian Sleeping Car.

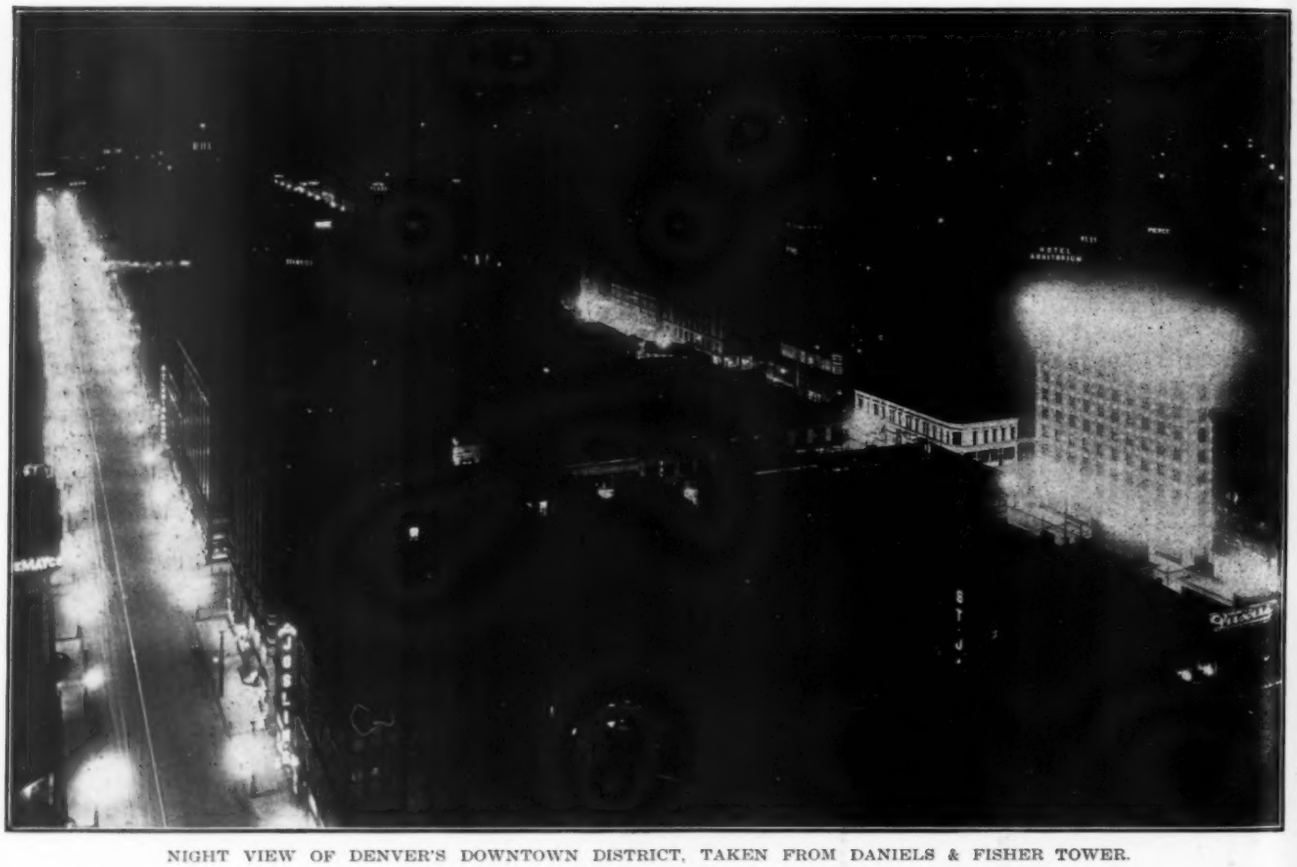
The electric lighting system on the car "Australia," which has recently been put into service on the Grand Trunk Pacific Railway, may well be said to be a work of art as regards the general illumination and finish of the numerous electric fixtures placed throughout, says the Canadian *Electrical News*. The equipment is controlled from a switchboard placed in one of the passages and which consists of two main five-point and one two-way switches; also by independent switches in the various staterooms and lavatories.

The power is supplied by a low-voltage axle-belt-driven dynamo suspended from the body of the car, with two sets of batteries working in parallel, one on either side. There are ninety-eight electric lights in all, made up of nine combination gas and electric fixtures with thirty-six electric lamps, fifty berth or reading lamps, and twelve single pendent lamps. In the upper deck there are nine combination center lamps, each having four sixteen-candlepower metallic-filament bulbs and one gas mantle, the whole inclosed in a beautiul embossed glass bowl, giving the light a very rich soft tone. Five of these handsome fixtures supply the main body of the car with light, while on either side there are twenty berth lights, provided with prismatic lenses, which throw the light where it is mostly needed. These are controlled by switches conveniently placed at the bottom of the individual fixtures.

SPECIAL ILLUMINATION IN DENVER.

THE "CITY OF LIGHTS" IN FULL GLORY.

On the evening of July 29, the Denver Gas & Electric Company, cooperating with the Denver Tramway Company, the *Denver Post*, the municipal authorities and business interests of Denver, carried out a scheme of special electric lighting which was interesting both as a test of the electric company's overload capacity and as a well-carried out idea for civic advertising. Although Denver has well earned the title, "City of Lights," the illumination exceeded the customary lighting to such an extent that the down-town district was practically as brilliant as in



NIGHT VIEW OF DENVER'S DOWNTOWN DISTRICT, TAKEN FROM DANIELS & FISHER TOWER.

full daylight. Thousands of people thronged the streets to see the city in its full glory of light.

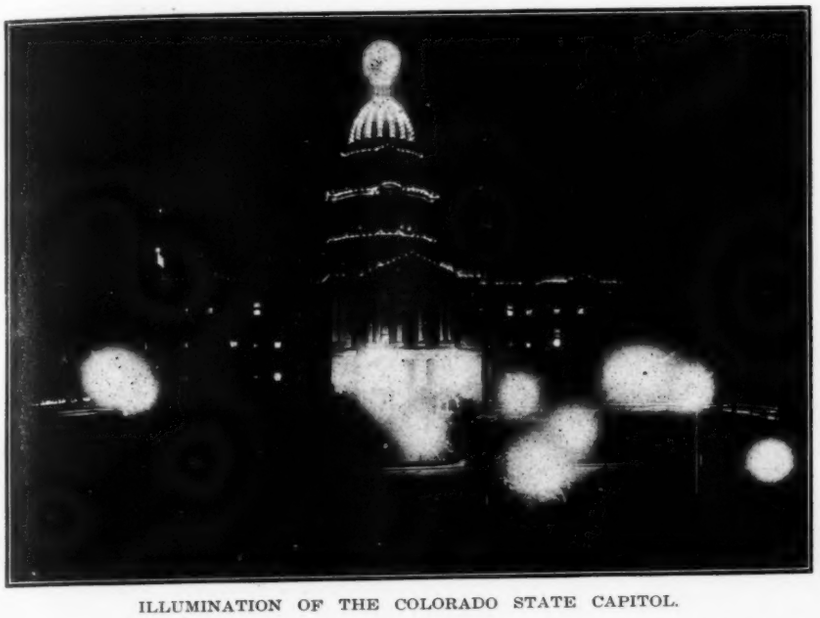
The scheme, originating in the sign department of the Denver Gas & Electric Company, provided for a complete illumination of practically all the down-town streets and office buildings between the hours of 8 and 9 on this particular Saturday evening. The idea was to show how the city looked when every available light was turned on for an "hour of light." Consequently not only the exterior lighting, outline lighting and electric signs were fully displayed, but the inside lights in practically all stores and offices fronting on the downtown streets were turned on.

Of special interest were the store and high tower of the Daniels & Fisher building and the State Capitol. The former was brilliantly illuminated with electric lights of various colors arranged in a very artistic and striking manner. The effective electric outlining of the latter presented an exceedingly pretty picture.

As an additional display one of the company's electric trucks bearing a representation of the devil and his mother-in-law passed through the main illuminated streets distributing tickets for a prize drawing.

The publicity feature of the display was handled by the *Denver Post*, which published preliminary notices, printed cartoons and made offers of various prizes. One of these was a prize for the best amateur photograph of the illumination.

The lighting load carried during the hour of special illumination was estimated at about 10 per cent over the ordinary evening peak load of 15,000 kilowatts that is normally carried by the Denver Gas & Electric system. The power was furnished by a 4,000-kilowatt Curtis horizontal turbo-generator and a 2,250-kilowatt vertical unit at the West station, a Parsons 1,000-kilowatt and 3,000 kilowatt machine at the Lacombe plant, and a 6,500-kilowatt alternator in the hydroelectric plant at Shoshone.



ILLUMINATION OF THE COLORADO STATE CAPITOL.

VIEW OF CURTIS STREET, DENVER, WITH ITS WEALTH OF ELECTRIC SIGNS.

THE DANIELS & FISHER TOWER, DENVER.

Electric Street Lighting Gains Ground.

The whole of the public street lighting in Marylebone, London, England, has now been converted to electric light.

Dismal Failure of Gas in the Coronation Illuminations.

In reviewing the achievements of the recent coronation illuminations in London and throughout the United Kingdom, *The Electrician* (London) says:

Now that the coronation is over we have an opportunity of reviewing dispassionately the displays made by the three illuminants which figured most prominently in the celebrations—(1) electricity, (2) gas, (3) candles. As far as electricity is concerned, there can be no denying that the displays made in London and the provinces were upon a scale of magnitude and magnificence not previously attempted. As far as we can judge by the reports sent in to us there were practically no cases of fire due to electrical causes as the result of bad workmanship or the action of bad weather upon the illumination material. In fact, the electrical in-industry can pride itself upon having secured a huge success for electric lighting and also upon giving to the celebrations an after-dark display which would not have been possible with any other illuminant.

The advocates of gas must in great measure lay the blame upon the clerk of the weather for the sorry figure cut by their carefully-planned devices and schemes. In London the principal evenings of the celebrations were marked by windy and wet weather, and these two components of the elements were responsible for the painfully complete failure of the gas display. Where open piping with punched holes was used, either for outlining a building or for lettering or some heraldic device, the effect of the wind was to either blow out the whole of the jets or to cause various sections of these to light up at spasmodic intervals, the sections themselves being badly "out of phase." For instance, in Piccabilly "God Save our King and Queen" was a huge gas device surmounting one of the buildings overlooking the Green Park, and the combinations of letters which the wind permitted the gas to display were always amusing but never dignified.

In the provinces much the same thing happened. In Brighton one of the large hotels attempted to display Britannia and the lion and unicorn in gas jets. A local correspondent informs us that Britannia has never cut such a sorry figure before, it being possible for her to show on occasions only one or two prongs of her trident. The lion and the unicorn remained practically invisible beasts, except for a stray whisker, a hoof or a horn, according as the caprice of the wind permitted.

As far as we are able to gather, the gas interests were able to create a record in the perfuming of the scenes of their would-be celebrations with the now well-known and easily recognizable odor. Where an attempt was made to protect the gas flame with small colored globes the result was practically the same, the rain quickly filling up the globes and effectually dousing the gas jet. Surely our gas friends should see in these signs and portents "the writing on the wall." If the elements are arraigned against them in this unfriendly way they should realize that the day of gas as an illuminant is gone. We are quite prepared to give them their legitimate position for heating and cooking, but so far as lighting is concerned we can only say "Let the public decide," and if this decision is influenced by the coronation illuminations then the day will not be far distant when the users of gas as an illuminant will be legally proceeded against. As far as candles are concerned their chief merit lay in the fact that they came to the rescue of the gas people in the predicaments above referred to.

Electric Lighting of Automobiles.

A paper entitled "The Electric Lighting of a Motor-Car" was read by A. G. New at a recent meeting of the Royal Automobile Club, of London, England. For a summary of this paper we are indebted to *Electrical Engineering*. The author emphasized the advantages of electrical over other methods of lighting for automobiles. For a complete equipment, two lamps of from sixteen to thirty-two candlepower were needed for the headlights, with two side lamps of four to nine candlepower, and interior and back lamps of four candlepower each. It was, however, seldom necessary to have head lamps and side lamps on at the same time. Thus for traveling in open country some seventy-two candlepower is necessary, and for standing idle about sixteen candlepower. These outputs are rather large for batteries of moderate size to maintain for any great length of time, and the author regards a self-containing means for charging the battery as practically essential. Quite a small battery can then be carried.

The various dynamos which have been designed and put on the market were then considered. Some are merely modified from the constant-speed form of construction by having permanent field magnets. These make no direct attempt to obtain any very close approximation to a constant rate of charge at all speeds, though they reduce the degree of deviation sufficiently to permit of full-range use. Others still retain the old constant-speed characteristics, but are furnished with mechanical-governor contrivances of one sort or another which either control the speed of the dynamo (friction-clutch fashion) so that it does not attain a high speed, whatever the engine may do that drives it, or which cut it out of action when its speed exceeds that which can safely be used. Others, again, are so constructed electrically that they automatically tend to keep down their powers of generation and thus aim at constant-current production irrespective of speed.

Just as there are numerous methods in vogue for regulating the output of the dynamo to prevent over-running and to give it variable-speed characteristics, so quite a number of different principles have been adopted to cut the dynamo in and out of circuit at minimum speed. Some are mechanical, taking the form of switches, operated by a governor mounted upon the revolving shaft; others are electrical in their action, controlled by the current itself passing through electromagnets that actuate the necessary contact-making arm, and there is one well-known system in which the use of any automatic cut-out at all is dispensed with by the employment of a free wheel clutch which permits the dynamo to continue revolving as an electric motor driven by the battery when otherwise it would be brought to rest while still in circuit, and so caused to consume a very undesirable amount of current. The author was in favor of the control being as automatic as possible. Further points dealt with included the method of fitting these dynamos to existing cars, and very satisfactory experience with some of these car-lighting systems was recorded.

A strong movement is on foot to establish wireless connection between Hong Kong and Singapore, and the shipping and business interests are deeply interested in the plan and are anxious for its early adoption.

Ornamental Street-Lighting System for Peoria, Ill.

For some time the retail merchants on Adams Street, one of the main thoroughfares of Peoria, Ill., have been discussing the matter of establishing an ornamental street-lighting system. Quite recently it became necessary to repave Adams Street with a creosote-block paving, and it was decided to lay the underground mains for the street-lighting system at the time the street was opened so as to economize upon the cost of construction. The cost of installation on Adams Street was $2.20 per property foot.

All the wires in the district are underground, and connection is made from the underground system to each of the street standards. The Peoria Gas & Electric Company furnishes current from its three-wire, 104-208 volt, sixty-cycle distribution system. Switching is accomplished through the medium of solenoid switches placed in manholes and controlled from the central station. The underground wires are laid in fiber conduit and the installation was made by G. M. Gest, of New York and Chicago.

LIGHTING OF ADAMS STREET, PEORIA.

The posts are known as the Corinthian standard, manufactured by the Flour City Ornamental Iron Works, of Minneapolis, Minn. The standards are equipped with four sixty-watt tungsten lamps in the four arms and these burn from dusk until midnight. The center lamp is a 100-watt tungsten lamp and burns from dusk until dawn. This makes a current consumption of 2,500 kilowatt-hours per year for the center lamp and 4,000 kilowatt-hours per year for the side lamps. The city pays for the current and the maintenance of this system from the general lighting fund, and the lighting company receives approximately $50 per year per post. There are sixty-three posts installed on the five blocks which form the present installation. On an average there are twelve posts to a block, six on each side of the street.

Similar projects are under way in other portions of the city and it is expected that this installation will point the way to a better lighting system throughout the city. On Moss Avenue, a residence street, the matter is now under way and foundations for seventy-four posts are in place.

Electric Power from India's Heavy Rainfall.

United States Consul E. S. Cunningham, of Bombay, India, has supplied further particulars regarding the interesting project of the Tata Hydro-electric Power Supply Company, which has been organized to furnish power for industral purposes to the section of western India, near Bombay. This power will not be derived from permanent streams, but it is the company's intention to gather in reservoirs the very heavy rainfall, and use it for creating electric energy.

During the monsoon season, from the middle of June to the middle of September, there is a rainfall on the west coast of India that averages 175 inches at Lanouli, sometimes greatly exceeding this average. In the early part of the present century there was conceived the plan of storing this water and utilizing it for industral purposes. After thorough investigation and reports of engineers, the money was practically secured in Europe in 1907, but final arrangements were not made, and as a result the entire capital of 20,000,000 rupees ($6,486,666) has been subscribed in India, making the enterprise purely an Indian undertaking. The present company was formally registered on November 7, 1910. It is the intention at first to supply 40,000 horsepower, which will probably be increased in the near future.

It is planned to construct three lakes or reservoirs. The Lanouli Reservoir, which will store water to be used during the three months of the monsoons, will be large enough to hold sufficient water during the longest breaks in the rain at that season. It will approximate 1,000 acres, formed by a dam 3,800 feet long and 26 feet high, and its cubic capacity will be 380,000,000 feet. The Walwhan Lake is the second reservoir and is to serve for the remainder of the year. It will be situated about a mile and a half from Lanouli, and will be formed between two spurs of hills by a dam 4,500 feet long and about 68 feet high. The area of the lake will be approximately 2.5 square miles, with a capacity of 2,600,000,000 cubic feet. The dam will be of solid masonry fitted with sluices.

Later on it is expected that a third reservoir will be constructed beyond Walwhan Lake, with which it will be connected by a tunnel nearly a mile long running through the dividing ridges of steep hills which will form a watershed some 1,200 feet above the level of the valley. This reservoir will have an area of 3,174 acres, or nearly five square miles, with a capacity of 7,000,000,000 cubic feet of water.

The water, traversing an aggregate distance of nearly four miles, will be led through masonry ducts from the lakes to the forebay, situated 2,040 feet above sea level. Here it will enter pipes six feet in diameter, which will run down steep slopes and precipes to Khopoli. The head will be a little over 1,730 feet, the static pressure being 680 pounds per square inch. The generating station will be at Khopoli, 300 feet above the sea and ninety miles from Bombay, where it is planned to use the energy for manufacturing purposes.

The water supply, as has been stated, is dependent entirely upon the rainfall. This has been made a question of prolonged study, and engineers who have surveyed the grounds say that there is no danger of a shortage of water, but that the power is practically certain.

TELEPHONY—TELEGRAPHY, and WIRELESS.

LINE-CONDUCTOR REQUIREMENTS FOR TELEGRAPH TRANSMISSION.[1]—III.

BY FRANK F. FOWLE.

The assumed life for copper is fifty years, based on what the wire ought to do under reasonable conditions. Large wires will last longer, of course, than small ones, owing to greater strength. As a matter of fact, copper ought to last indefinitely under favorable conditions, because it suffers no corrosion. Its life in service is usually terminated by such factors as heavy sleet storms, the necessity of taking down and moving whole pole lines, gradual stretching and periodical removal of slack, and sometimes by annealing—caused by very heavy foreign currents or exposure to fire. It is also very sensitive to rough handling and often fractures under stress at a small nick or furrow in the surface.

The assumed life for copper-clad is also fifty years, arrived at after a careful study of the properties of the wire and its manufacture, also taking into account the experiences up to this time of numerous users of it. The life of copper-clad ought to be greater, for some reasons, than the life of copper. It is more hardy mechanically and need not be so carefully handled. The tensile strength resides to a great extent in the steel core, which is a large advantage, making it less likely to fracture from nicks or scratches. Compared size for size with copper, it will fail under sleet and wind loads much less frequently and stretch less. It has a much higher elastic limit of strength than copper and consequently relieves itself of stresses due to overloaded spans to a greater degree; this comes about through the increased sag which results from elastic stretching of the conductor. In many cases where copper would stretch permanently, coper-clad will not. Copper is by no means an ideal conductor mechanically—in fact, we tolerate its defects in that direction for the sake of the needed conductivity. On the other hand, copper-clad is much superior mechanically and its welded copper jacket presents the same resistance to external corrosion as solid copper. The only other place where corrosion can attack the wire is at exposed ends; and experiments made to determine this, under conditions tending greatly to accelerate it, show an absence of corrosive action at the weld and a tendency to corrode at the center of the core, but not penetrating to a serious extent. This is quite the opposite result from corrosive tests on the early bimetallic, non-welded wire.

The assumed life of iron, of the B. B. grade, double galvanized, is twenty years. This figure is rather high, but has been made so purposely, in order to be conservative in comparing iron with copper-clad. A life of fifteen years is probably more representative of average conditions.

The comparison of first cost and annual charges, per mile, is given in Table 6. Attention is called to the fact that the gauge used in the table is B. & S. for copper and copper-clad and B. W. G. for iron.

TABLE 6.
FIRST COST AND ANNUAL CHARGES PER MILE OF WIRE.

Size.	First Cost—Copper.	First Cost—Copper-Clad.	First Cost—Iron.	Annual Charges—Copper.	Annual Charges—Copper-Clad.	Annual Charges—Iron.
No. 6	$65.66	$55.49	$27.61	$6.05	$5.76	$4.36
No. 7	53.83	45.74	23.48	5.17	4.94	3.87
No. 8	44.44	38.04	21.11	4.47	4.29	3.58
No. 9	37.24	32.11	18.64	3.94	3.79	3.29
No. 10	31.33	27.25	17.14	3.50	3.38	3.11
No. 11	26.82	23.51	15.38	3.17	3.07	2.90
No. 12	22.94	20.44	14.38	2.88	2.81	2.78
No. 13	20.21	18.16	13.27	2.68	2.62	2.64
No. 14	17.79	16.16	12.39	2.50	2.45	2.54

The table shows that size for size copper-clad is cheaper than copper from nine per cent to fifteen per cent, in first cost. But the comparison of cost on a basis of equal transmission efficiency must be made on a basis of equal resistance and in terms of annual charges. This comparison appears in Fig. 4, where the annual charges are plotted in terms of ohms per mile.

These curves show that in respect to resistance, alone, copper is the cheapest material of all and copper-clad steel second, while iron is the most expensive. It may be emphasized that the showing for iron is the best that can be made, assuming it to be new; but when corrosion commences the resistance will increase and then it becomes still more expensive. On a conservative basis, in fact, some increase in resistance should be allowed for at the outset, so that the desired transmission limit will not fall short of requirements before the wire reaches the end of its usefulness or life.

This comparison takes no account, however, of tensile strength. The choice evidently lies between copper and copper-clad, in the first place, on the score of economy. It only remains to take up the question of strength. Obviously

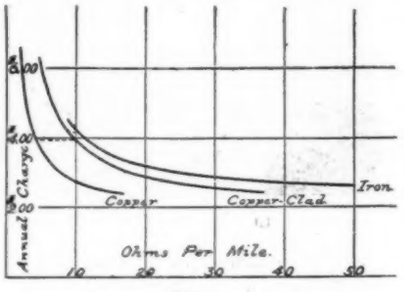


FIG. 4.

copper would be the chosen material for any requirement if it possessed the strength to stand up mechanically. But we know from experience that sizes smaller than No. 9 B. & S. lack strength and even this size fails occasionally in severe sleet storms, and stretches frequently.

The operative limit of such a wire is 437 miles and hence copper is the proper material for lines of this length or greater. But No. 9 B. & S. copper-clad, which is only a trifle less expensive on the score of annual charges, has considerably higher resistance and in consequence an operative limit of only 290 miles. Therefore No. 9 B. & S. copper would be used for all lines between 290 and 437 miles in length. But copper-clad is more economical for all lines less

[1] A paper presented before the Association of Railway Telegraph Superintendents at its thirtieth annual convention, Boston, Mass., June 27.

than 290 miles in length—simplex transmission being always assumed.

This establishes the field for copper-clad in telegraph service, as comprising the lines in general less than 300 miles in length, based on conditions as we find them at present. Where automatic-repeater stations can be installed, or now exist, the economical range can be extended very greatly.

For later convenience the weights of the mile-ohm of the three kinds of wire here considered are given in Table 7, assuming a temperature of 68 degrees Fahrenheit, a conductivity of 98 per cent of pure annealed copper for hard-drawn wire, and 40 per cent conductivity ratio of copper-clad to copper. In the same table are given the tensile strengths in pounds per square inch for a size of about No. 9 B. & S.

TABLE 7.
MILE-OHM AND TENSILE STRENGTH OF WIRE MATERIALS.

Material.	Mile-Ohm. (Pounds)	Tensile Strength. (Pounds)
Hard-drawn copper	895	60,000
Copper-clad steel	2,075	95,000
Galvanized iron	5,600	55,000

It is also convenient to have the operative limits of various sizes of wire of each kind. These are given in Table 8, where the sizes of copper and copper-clad refer to the B. & S. gauge and iron to the Birmingham gauge.

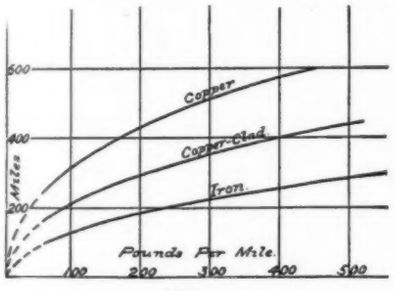


FIG. 5.

TABLE 8.
OPERATIVE LIMITS OF DIFFERENT KINDS AND SIZES OF TELEGRAPH WIRE.

Size.	Operative Distance, in Miles. Copper, (B. & S.)	Copper-Clad, (B. & S.)	Iron, (B. W. G.)
No. 6	585.	397.	306.
No. 7	535.	358.	274.
No. 8	485.	322.	253.
No. 9	437.	290.	229.
No. 10	395.	261.	209.
No. 11	357.	235.	187.
No. 12	321.	211.	172.
No. 13	289.	188.	150.
No. 14	260.	169.	....

Fig. 5 shows in the form of curves the required weight, in pounds per mile, of a conductor for simplex transmission for any required distance.

While the economical field for copper-clad, under existing conditions of insulation, comprises the lines of 300 miles or less, its field can be extended to 600 miles if the insulation is raised to one megohm per mile. This means, of course, the adoption of better insulators. While this implies an increase in the cost over the present glass insulator, there is every reason to believe that it will be a final economy of no small importance.

METHODS OF IMPROVING TRANSMISSION.

The best conditions for securing the desired transmission most economically have already been covered in part. These will now be recapitulated and several new features added.

(*1.*) *Source of Electromotive Force.*—Divide the total electromotive force into two equal parts and place one at each terminal. The lumping of the whole electromotive force at one terminal is the least efficient arrangement possible.

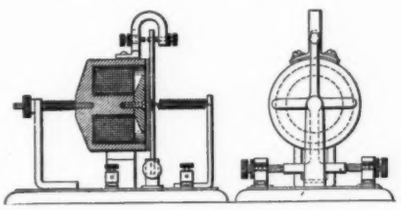


FIG. 6.

Use power generators, motor-generators, or dynamotors instead of batteries wherever feasible and economical.

When batteries are necessary, operate but one line per battery, except where the lines are short and the margin ample.

(*2.*) *Terminal Resistance.*—Keep the total terminal resistance at a minimum. Use resistance lamps with iron filaments instead of carbon. Also keep the terminal resistances as nearly equal as possible.

When a generator or some equivalent source of electromotive force is employed, never use one lamp tap for more than one line, unless the lines are short and the margin ample.

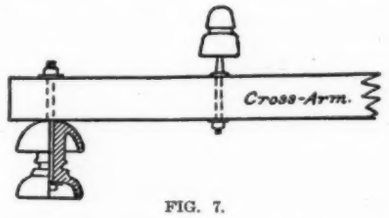


FIG. 7.

(*3.*) *Circuit-breakers.*—An automatic circuit-breaker, of special design, is recommended as a substitute for the lamp resistance. This will avoid the resistance in large part and provide fully as much safety. The circuit-breaker can be arranged, if desired, to cut in the protective lamp resistance instead of opening the line entirely.

(*4.*) *Relay Windings.*—The most efficient insulating material known for magnet windings, with wires of small size, is enamel. It occupies less space than a covering of single silk. Consequently the necessary number of turns can be secured with less total resistance.

The neutral relay in a quad set is most in need of improvement, comparatively, and here enamel will be of special advantage. One manufacturer who makes both polar and neutral relays uses enamel with the former and silk with the latter; the practice ought to be reversed—but better still, enamel should be used entirely.

(*5.*) *Artificial Lines.*—The artificial lines employed in duplex and quad equipments, with their lumped resistance, capacity and leakage, are exceedingly crude imitations of a real line with the same properties uniformly distributed.

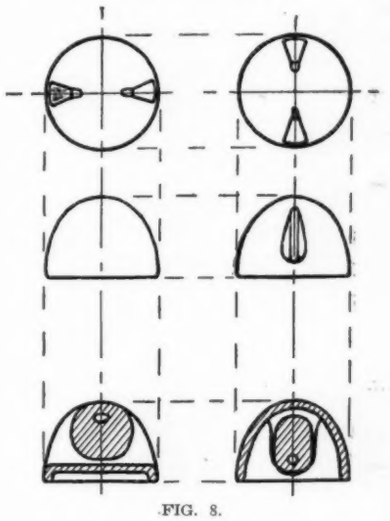


FIG. 8.

Improvement in such equipment, along the pattern of the artificial line described in this paper, will help in extending the range of transmission. The plan may also be carried so far as to provide the artificial line with the electrical equivalent of the distant terminal, which is likely to be of most benefit when the line insulation is at its maximum. The design of such a line offers no serious difficulties, but it will be somewhat more expensive.

(*6.*) *Relay Design.*—This subject has been treated at some length in the author's American Institute paper, but the point to be emphasized is the fact that the use of enlarged pole-pieces, with a magnetic circuit of a certain class, increases the pull on the armature. Putting it differently, the pull now obtained

in a 150-ohm relay can be produced in a relay of the new type with only a small fraction of that amount of resistance. An improved design after this principle appears in Fig. 6. The practical advantage of this type, aside from its improved mechanical structure, is the ability to further reduce the terminal resistance and thus use a lighter wire than would be required with 150-ohm relays—or a wire of higher resistance.

(7.) *Improved Insulators.*—The advantages of better insulation have already been demonstrated. The means of securing it will be discussed briefly. There is already some experimental evidence, although not extensive, that glazed porcelain makes an insulator superior to glass. But one of the prominent faults of the standard glass insulator is its form, coupled with the method of mounting it. Dependence for insulation is placed primarily on maintaining a dry interior under the outer petticoat, but this fails of realization on account of spattering of water (during rainfall) into the petticoat from the top surface of the cross-arm beneath the insulator.

A superior method of overcoming this appears to be the use of an insulator placed beneath the cross-arm and held by a rigid pin, after the plan shown in Fig. 7. This removes the objection of spattering from the arm and is mechanically just as rigid as the present standard; a large under-flange is employed to prevent the tie-wire from slipping down.

A more radical proposal is the use of a flexible suspension with a strain insulator of the type shown in Fig. 8. This plan is suitable for straight portions of pole line, and owing to its flexible character will tend to reduce wire-stripping in a heavy sleet storm. The insulator itself is suspended from the cross-arm by a loop of wire, and the line wire is supported in turn from the insulator by means of a tie-wire. Attention is called to the form of tie, which is wrapped around the line from each side toward the center, in opposite directions, with the ends pig-tailed at the center; it is practically impossible for it to fail except by fracture. These plans for improving the insulation, and others, are discussed in the other paper[1] before the American Institute of Electrical Engineers more fully than space permits here.

1 See *Proceedings* of the American Institute of Electrical Engineers, June, 1911, pages 1187 to 1242.

LETTERS TO THE EDITOR.

Relative Efficiencies of Iron and Copper Wire.

To the Editor:

In your issue of May 27, 1911, I have come across an article by Mr. Thomas B. Doolittle in which he gives a table representing the relative efficiencies of iron and copper wire for telephonic transmission. According to this table BB iron although having seven times the ohmic resistance of copper wire and nine times the effective resistance, has an efficiency for telephone transmission of 26 per cent as compared with copper. In other words as I understand it, it would be possible to talk over twenty-six miles of such iron wire strung as indicated by Mr. Doolittle with as great clearness of audition as over 100 miles of hard-drawn copper. If this is a fact why is there not more iron wire used for telephone lines?

Is such a comparison of the relative efficiencies of iron wire and copper based on actual experiments or is it based on theoretical determinations? If it is the latter where am I likely to find the formula from which it is derived? I note that the table is based on assuming that the permeability of iron wire is 100. As Ewing shows that the permeability of iron is considerably lower than 100 with low intensity of magnetization, I presume the value of 100 is based on that intensity of magnetization which corresponds with the average current flowing in long-distance toll lines. If this is the case then will you be good enough to advise me what average current in an iron wire corresponds to the permeability of 100 as assumed? Also advise whether that current is that which is the usual average both for short-distance transmission and for long-distance transmission of speech. C. W. Davis.

Sewickley, Pa., June 29.

[This communication was submitted to Mr. Doolittle, and we are pleased to publish herewith his reply to Mr. Davis' inquiry.—Ed.]

In the matter of Mr. C. W. Davis's letter of June 29 to you concerning the relative efficiencies of copper and iron circuits, discussed in my article in the May 27 issue of the Electrical Review and Western Electrician, I would point out that in open-wire circuits the resistance of the wires is not the only factor which determines the telephonic efficiency of the circuit. Inspection of the figures given in my article will show that while the effective resistance of the iron wire considered is about nine times as great as for the corresponding copper circuit, the inductance of the iron circuit is very much higher than the inductance of the copper circuit.

Our experience with iron line wires has indicated that their permeability does not vary greatly for a considerable range of current strength in the region of ordinary telephonic current densities. The figure of 100 used in my article is, I think, a fairly good general average for new BB wires used for telephone circuits. Your correspondent will appreciate, of course, that there is not only a great fluctuation in current strength at the sending end of a telephone circuit, but also that in any given circuit the current in the wire diminishes rapidly in passing along the circuit. On this account, it is difficult to give any general figures for average current strength of telephonic frequency. In general the average current on a long line would be smaller than on a short line of similar construction under the same terminal conditions.

The computations for the comparative efficiencies quoted in my article are theoretical and in the case of iron are based on new wire. For your correspondent's information I would say that the general formulae for current attenuation on telephone circuits can be found in Oliver Heaviside's Collected Papers.

With regard to the query as to why iron is not more generally used in telephone circuits, I would say that the efficiency figures which I have quoted are about the most favorable that can be drawn for iron wire in that I have taken new wire of about the smallest diameter used commercially. With larger sizes the relative superiority of iron over copper in the matter of inductance decreases and the ratio of effective resistance goes up very rapidly. The efficiency of iron circuits also diminishes with time. Experience has shown that, except in regions where the conditions are particularly favorable to a long life for iron circuits and where the questions of transmission efficiency are not of great importance—a point, by the way, which it is becoming rapidly less easy to meet, owing to the greatly extended use of telephone

service—iron circuits are not as economical as copper circuits in a going plant where cost must be considered over a long period of years.

THOMAS B. DOOLITTLE.

New York, July 25.

Wireless Stations on the French Coast.

The French coast has a length of 1,900 miles on the North Sea, the British Channel, the Atlantic Ocean, and the Mediterranean Sea. All this coast line is passed by ships belonging to the most important carrying companies in the world, Homeward bound ships, except a few from America, going to all the important European points have to pass this coast line, so that the French coast stations are already of great value for wireless communication, and will be more valuable still in course of time. The French coast stations belong partly to the post and telegraph office and partly to the navy. The post stations are public only. The navy stations can be used by the public, but only when no service messages have to be sent or received.

The important station at Boulogne was erected with full consideration of the proximity of several other public wireless installations at Scheveningen, Nieuport, the North Foreland, Crookhaven, etc., and of the fact that the small width of the Channel, which is nowhere greater than 200 miles, and the heavy traffic through it creates many difficulties in preventing interference between messages. Hence at Boulogne, for the present, electric waves are sent in one direction only, with a range of about 200 miles. The wave-length is about 330 yards.

Another station is to be erected at Le Havre, from which port 6,300,000 tons of shipping depart annually, chiefly to America. At Onessant a station has been in operation since 1904. It despatched 428 messages in 1909. Its range is about 400 miles, and the wave-length 2,000 feet. The telegraph office has as yet no wireless station on the Bay of Biscay, but one at Bordeaux is in contemplation with a range of 200 miles.

Marseilles is clearly the most suitable point for a wireless installation for the Mediterranean as it is the most important port in France. However, as deep indentations mark the coast near Marseilles, it was thought best to erect the station thirty miles to the west of the city, at Saintes Maries de la Mer at the mouth of the Rhone. The station has a range of about 400 miles with a wave-length of 2,000 feet. This station has worked most satisfactorily as regards communication with ships to the west and south of it, but towards the east it leaves much to be desired, so much so that a plan is on foot to build another station near Nizza at Cros de Cagnes, with a range of 200 miles or thereabouts. On the island of Porquerolles near Toulon there is a small station with a range of 120 miles, using a wave-length of 1,000 feet.

The French postoffice has also a wireless station at Fort de l'Eau on the Algerian coast, with a range of about 400 miles, and a wave-length of about 2,000 feet. This station and that of Sainte Maries, although they are nearly 500 miles apart, exchange greetings regularly every hour. Ships often prefer to communicate with these two stations rather than with those which are nearer and slower to respond. Although the normal range of each of the two coast stations is only 400 or so miles some extraordinary things have been done at times. Thus the Saintes Maries station has communicated with ships in the Red Sea, at a distance of 2,500 miles, a greater distance than that between Glacier Bay and Clifden.

The naval stations also open for public use are at Dunkirk, Cherbourg, Brest-Keilaer, Lorient, Rochefort, and Ajaccio (Corsica). All these stations have a range of 400 miles by day and three times that distance by night, and use 2,000-foot waves. The stations at the arsenal at Brest, Toulon, Oran (Algiers) and Brizerta (Tunis) are for naval use only.

The army has wireless stations at all important strategic points, especially on the German frontier at Toul, Belfort, Epinal and Verdun. These stations use from ten to fifteen horsepower. The Eiffel Tower is particularly interesting. The apparatus is in an underground room at the foot of the tower, and the energy employed is seventy-two horsepower. The range is at least 2,000 miles, and communication has been made between Paris and Glacier Bay, a distance of about 2,500 miles, thanks to the recent installation of the singing blow-out system. Its situation and power mark the Eiffel Tower station the chief in France. It is of special importance with regard to the African Colonies, and the French Government has established a chain of wireless stations in Africa whereby full communication at all times is insured between Paris and the most remote parts of the Colonies. Besides the stations at Fort de l'Eau and Oran already mentioned there are several inland stations in Algiers, the most southern of which is at Colomb Behar near the Morocco frontier. The Senegal district has stations open also to the public at Port Etienne, Rufisque and Dakar. In the French Congo stations are in course of erection at Loango and Brazzaville, with which a projected station near Lake Tchad will communicate.

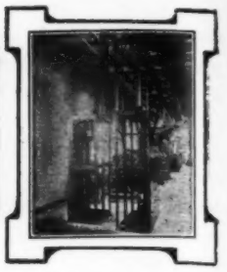
France is also erecting a wireless station in Liberia, at Monrovia, which will secure uninterrupted intercourse with Algeria and hence with Paris. There are also French stations at Majunga in Madagascar and on the island of Mayotte in the Comoro Islands, about 200 miles due north of Madagascar.

France has 140 warships and thirty-one merchant ships fitted with wireless apparatus. A large number of the stations are on the Carpentier-Gaiffe-Rochefort system, the commercial exploitations of which is in the hands of the Compagnie Generale Radiotelegraphique, which has purchased the French rights to the patents of the German inventor von Lepel, from the Anglo-German Wireless Syndicate. Having taken part in the international agreement of November 3, 1906, France has adopted since May 15, 1910, a price at coast stations of forty centimes a word (formerly seventy-five).—*Electrical Engineer*, London.

Western Bell Telephone Companies Merge.

Newspaper dispatches state that all the Bell telephone companies operating in the Rocky Mountain states are to be merged into a large single company with headquarters at Denver, Colo. The lines of the consolidated system cover Colorado, Wyoming, Montana, Arizona, New Mexico and parts of Oklahoma, Texas, Utah and Idaho. The Colorado Telephone Company is the nucleus of this network. E. B. Field, president of the Colorado company, will be the executive head of the new organization, which will be known as the Mountain States Telephone & Telegraph Company. It is understood that its capital stock will aggregate $50,000,000.

Industrial Power



ELECTRIC DRIVING OF CONTINUOUS ROLLING MILLS.[1]

BY G. J. HOOGHWINKEL AND F. THURSFIELD.

From their peculiar properties, electric motors are particularly applicable to mill driving as compared with steam engines. The steam-engine speed is limited, and costly gears are needed to connect it even to slow-running mills; the maximum turning moment is fixed by the size of cylinder and the steam pressure, and is incapable of any increase. Consequently it is very common practice to allow the engine to run above normal speed before the piece enters, and gradually slow down during the succeeding passes. This is just the reverse of ideal, the higher speed being preferable at the end of the process.

The motor, on the other hand, can be built to run at any speed and coupled direct to the mill, if desired. Its maximum turning moment is practically unlimited, and there is no difficulty in maintaining an approximately uniform speed throughout a given process. At the same time the load on the motor may be accurately limited to any desired amount, in order to avoid accident.

The advantages usually claimed for the electric driving of rolling mills are: (1) greater fuel economy; (2) lesser up-keep and running costs, especially at week-ends; (3) larger output; (4) advantages of centralization; (5) the economy is permanent, and does not diminish with wear; (6) the energy spent in rolling is easily measured; (7) saving in space, especially useful in all older works.

The question of economy entirely depends on circumstances. A large number of the mills in the Black Country are driven by steam generated from the waste heat of the coal-fired furnaces. With this system, in many cases ample steam is produced for driving the mill, and the cost of power consists of the attendance and stores, plus the capital and maintenance charges on the engines, the numerous small scattered boilers, and the ramification of steam pipes needed to combine them. Though these upkeep charges are undoubtedly heavy for the power of the plant, they are small as compared with the cost of electrical energy for the work performed. If, however, the cost of fuel used in the furnaces is taken into consideration, it will be seen that it is a very large item in the production of, say, a ton of rails as compared with the cost of the electrical energy needed for rolling. A ton of rails can be rolled from the ingot for about sixty kilowatt-hours, or for, say, forty-eight cents, taking current at 0.8 cents per unit. With improved regenerative furnaces, the Pather Iron & Steel Company claims to have saved 0.35 tons of coal per ton of metal, to have reduced the wastage of metal by from 2.5 to 5 per cent, and to have lowered the cost of repairs. These economies would very well cover the forty-eight cents per ton for rolling.

As to capital cost, this will not be a very serious item where both electric power and gas can be obtained from a supply company. Taking ten per cent on the capital cost of the motors, switchboards, starters, flywheels, couplings, foundations, etc., it should not work out at more than six cents per ton of finished material, provided the plant is kept fully loaded. This small charge would be more than covered by the saving on the upkeep of boilers, pipes and engines, without taking into account the space reclaimed by the change.

As a guide to the relative cost of upkeep of the two classes of machinery under severe usage, the experience of the Mersey Railway Company may be quoted, where the upkeep of the generating station, conductor rails, motors and all electrical gear is six per cent less per train-mile than the maintenance of the steam locomotives. With an electric plant expenses are more definitely proportional to the work in hand. When the plant is idle, everything is shut off and no expenses are incurred.

It is now generally admitted that an increased output may be obtained from a given mill when electrically driven. This is due to two causes, (*a*) the more even turning moment, resulting in fewer hot bearings, breaking of couplings, etc., and (*b*) the more uniform speed, permitting the average speed to approach more nearly to the maximum. Both of these causes also favorably influence the quality of material produced.

It is only those who have had charge of an electrically driven mill who will fully appreciate the possible advantages of being able at any moment to check the power consumption. The power instruments will indicate any disorder in the mill, such as excessive thrusts and warm bearings, and will often be the means of avoiding breakdowns due to these causes.

Not only so, but valuable information has already been revealed as the result of electric driving, and the roll cutter, who has hitherto been guided mainly by practical experience, is now being assisted by an exact science. The relation of spread to pressure and roll diameter is being more clearly defined; the injurious effects of restricted spread are plainly indicated; and the tearing effect of undue pressure on a particular part of a section may be readily detected. By studying the power instruments it is possible to distribute the direct and indirect pressures uniformly over the various passes. By means of the electric drive the German Iron Masters' Association has acquired some quantitative results as to the correct grading of the draft to the temperature, so as to prevent molecular separation and obtain the highest possible output with a given plant. It has been shown that the power required

1 Abstract of paper read before the Staffordshire Iron and Steel Institute.

to displace a given volume of metal depends chiefly on the temperature, and is very little affected by the quality of metal or the section.

The economy to be obtained from electric driving will depend very materially not only on the proportioning of the various passes but on the actual usage of the plant. Where power is supplied by meter from a power company, idle running must be avoided at all costs. Care is also needed to see that not more than the correct number of pieces is allowed in the mill simultaneously, as the consequent overload can only be supplied at some expense in economy.

In connection with the various arrangements for electrifying existing mills, it is useful to point to an advantage of the electric drive which is rarely mentioned. Often one steam engine drives several mills, on account of its better efficiency. With electric driving, however, each train can be driven by its own motor, thereby saving during the time the mill is idle, as the efficiency of electric motors of various sizes, within certain limits, is nearly the same.

With reference to the power supply, four cases only need be considered: (1) a supply from a municipality or power company; (2) a supply from the gas company with private gas-engine power stations; (3) a private steam-turbine plant supplied from existing puddling furnaces or from coal-fed boilers; (4) an exhaust turbine supplied from an existing large mill engine to generate electricty for smaller mills and auxiliary plant.

(1) At anything near 0.8 cents per kilowatt-hour the electric drive will be cheaper than the steam drive with coal-fed boilers supplying modern non-condensing, compound engines, taking into consideration repairs, maintenance, wages, ten per cent for interest and depreciation, oil, waste, etc.

The steam consumption must be taken over twenty-four hours or over a year, and include all auxiliary plant. It is this point which is so often lost sight of by the advocates of the steam drive. The writers have found that with modern engines of the best types, and steam at 150-pounds pressure, thirty-five pounds per brake-horsepower per hour is a fair average taken over the whole year.

Taking an eight-inch and ten-inch merchant mill rolling rounds and squares at twenty brake-horsepower-hours per ton, with coal at $2.88 per ton, the fuel costs would be thirteen cents, and the total costs, including interest and depreciation, wages, etc., but no repairs or maintenance of boilers and engine, would be with an output of 30,000 tons, 27.2 cents per ton; with an output of 15,000 tons, 38.4 cents per ton.

With electric power at 0.8 cents per kilowatt-hour and an overall efficiency of sixty-two per cent we get the following: with an output of 30,000 tons, 24 cents per ton; with an output of 15,000 tons, 37.2 cents per ton.

The repairs and maintenance of the electric motor are, of course, quite small, and total maintenance, including gear ropes, etc., is quite out of proportion to the repairs and maintenance of costs of engine, boilers, pumps, gearing, etc.

The corresponding figure for the heavy rail mill at the Hildegarde works is 20.8 cents per ton, not including wages.

(2) The installation of gas engines to drive the electrical equipment in cases where no electric supply at low rates is obtainable, but where the mains of the gas company are within easy reach, is more or less a special case, and need only be considered in this particular district. The first cost of gas engines, dynamos and motor is higher than steam engines and boilers, and therefore the capital charges also increase. The fuel costs are about half, and maintenance and repairs are higher than with steam drive. Altogether it will be found that this method of driving does not present any specific advantages in general cases.

(3) By far the most important system of driving in this district is the utilization of the low-pressure steam from the puddling furnaces in steam turbines coupled to electric generators, enabling the larger works to produce for themselves the electric power required for their rolling mills and auxiliary plant. In most works the mill engines are old and highly uneconomical, the gearing is worn, and last, but not least, there is a general desire to speed up the mills and increase the production per mill.

The electric drive is inherently adapted to give this increased production and a more homogeneous product, and it seems that the old low-pressure steam engine is bound to go. The low steam pressure prevents in any case the installation of the more modern but costly compound condensing mill engine, even should this be desirable. The turbine, however, admits readily of the utilization of low-pressure steam; it possesses practically unlimited overload capacity, and can be easily regulated.

In many cases additional coal-fired boilers have been introduced to supplement the furnace boilers. This would have been quite unnecessary if the steam had been applied to steam turbines rather than to reciprocating engines. It is incorrect to say that, as steam is a by-product of the puddling plant, it costs nothing, and can be wasted in the old mill engines, especially if puddled bars are produced and sold at a loss in order to provide the waste heat. The production of this steam is represented by the loss on the puddled bars, together with maintenance, interest and depreciation on plant. The true value, however, is represented by the result which can be obtained from this wasted steam.

(4) If the capital outlay required for a complete turbine-driven electrical plant cannot be faced, a great improvement may be made by the aid of exhaust-steam turbines. In the case of a simple low-pressure non-condensing rolling-mill engine, the addition of an exhaust turbine will multiply the power from a given quantity of steam nearly threefold, and even if the mill engine is compound and condensing, the exhaust turbine will in most cases nearly double the energy available. By collecting the steam from the mill train and the forge steam hammer, and passing it through a turbine, sufficient power would be produced in many works to roll the puddled bars and drive all auxiliary machinery. In this way the number of puddling furnaces to be kept going might be considerably reduced, and in some cases coal-fired boilers might be entirely done away with. As an example of the saving to be effected, a 1,200-horsepower South German mill had a 500-kilowatt exhaust-steam turbine connected to it. The plant which this turbine displaced was of an efficient character, requiring only some eighteen pounds of steam per unit, or about 9,000 pounds per hour. Nevertheless, the saving amounted to about twenty-five per cent of the previous steam consumption.

Safety Devices on Electric Cranes.

Of late years the speeds of electric cranes have been increased considerably, but the provision of adequate safety devices to prevent over-winding and over-traveling has not always received the attention it merits, although in other applications of electrical power manufacturers have devoted a considerable amount of time and money to the problem of placing on the market automatic and "fool-proof" devices designed to secure immunity from accident due to errors of judgment on the part of the workmen.

The electrical equipment of a crane usually includes a main switch and fuses, and a branch fuse for each motor circuit, together with a rheostatic controller for each motor, no provision being made to prevent the attendant from switching on the current when the controllers are not in their "off" positions, as is generally done with the most ordinary motor-control gear. In several instances, however, the main switch and fuses have been replaced by ordinary overload circuit-breakers, which, in order to be effective in preventing accidents through mistakes of this character, should be of the free-handle type. There is, however, a decided objection to the use of ordinary circuit-breakers for this class of work, on account of the fact that very often the controller handles are so operated that a momentary large rush of current is produced, which though not of sufficient duration to do any harm to the electrical equipment is of sufficient magnitude to cause the circuit-breaker to open and bring the crane to a standstill. The resulting delays may be only trifling, but in the aggregate they are responsible for serious loss of time, and in foundries and steel works are the cause of other and more serious losses. To avoid this trouble, circuit-breakers, when provided, are generally rendered inoperative except under very heavy overloads, and so cease to afford any real protection against overloads of smaller magnitude, which may still be of sufficient duration to have serious effects on the remainder of the equipment.

In a system of control designed to overcome these troubles, the crane-control panel is equipped with a main circuit-breaker provided with a low-voltage release attachment, and instead of a branch fuse for each motor circuit, there is an overload relay with a time-limit device, by means of which a dangerous overload on any particular motor of sufficient duration to cause overheating or excessive sparking, may be entirely prevented. In addition, each motor controller is electrically interlocked with the circuit-breaker in such a manner that after it has once been opened by the application of an overload or through any other cause, it can be closed again only when the controllers are returned to their "off" positions and all resistance inserted in the motor circuits. It is thus rendered impossible for the attendant to make any mistake in the proper sequence of operations; and in case of failure of the supply voltage through any cause there is no possibility of an accident happening through the current being switched on again unexpectedly.

With the high traveling and hoisting speeds now in use, the need for suitable safety devices for limiting the hoisting and traveling motions has become urgent; but so far has met with little response beyond the occasional addition of a limit switch to the hoisting motion to prevent over-winding, and rarely also to the traversing motion of overhead cranes to prevent over-running. These switches are generally arranged in the armature circuits of the motors, and with their cable connections have to be of sufficient capacity to deal satisfactorily with the *maximum* currents possible in practice. Unlike ordinary circuit-breakers, they are not designed for interrupting heavy currents, and there is necessarily a considerable amount of wear and tear if they are brought into operation very frequently.

Such switches have not been generally applied to limit the travel of overhead cranes for several reasons, the principal one being that owing to the large amount of energy stored in a heavy crane when running at a high speed and carrying a heavy load, it is necessary, in order to prevent the crane from running over the end of the gantry, to arrange the limit switch so that current is cut off from the motors while the crane has yet a considerable distance to travel. The ordinary limit switch breaks the motor circuit entirely, and it is, therefore, impossible to cause the crane to continue to travel beyond the point at which the limit switches operate, although the switch is generally arranged so that it is possible to return in the opposite direction. It is therefore impossible in such a case to maneuver the crane anywhere near the ends of the gantry, and consequently a large proportion of the area included between the gantries must remain either unserved or very inefficiently served by the crane.

These objections may be overcome by special forms of limit switches, which operate by short-circuiting the low-voltage release device on the circuit-breaker of the crane-control panel. One form of this switch is designed for limiting the travel only, and is, therefore, suitable for the hoisting motion and the traversing motion, when the latter is made at moderate speed, as is generally the case. In the case of the traveling motion, which is generally made at a much higher speed, it is evidently desirable that within a certain distance of each end of the gantry it shall be possible to travel in either direction at such a reduced speed that the current may be cut off entirely and the crane brought quickly to rest when it is quite close to the end of the gantry, so that there is no danger of over-running. This may be effected by the use of a limit switch so arranged that when the crane is near the point where an ordinary limit switch would open the circuit entirely, the speed is reduced by the insertion of resistance in the traveling motor circuit, which quite close to the end of the gantry is opened altogether.

Another possible source of danger is the attainment of very high speeds when heavy loads are being lowered, and devices are now made which render a mishap of this kind impossible. The objection to very high speeds of lowering is that the motor which drives the hoisting motion may be driven at such a speed as seriously to injure, if not break, the fastenings of the armature coils, an injury which might result in the wreckage of that portion of the crane.

Canadian Hydroelectric and Smelting Plant.

A correspondent of the *Electrical Review* (London) states that American and English capital has been interested in the establishment of an electric smelting plant at Chats Falls, on the Ottawa River, about twenty miles west of Ottawa, Canada. This water power is capable of developing 141,000 horse-

power. A development of 20,000 horsepower will not cost over $8 per horsepower. Active work preparatory to the erection of the plant will begin early next spring. The country surrounding the Falls on the Quebec side of the Ottawa River is rich in iron ore, the only difficulty being transportation. It is, therefore, proposed to build an electric railway from the Falls to the mines.

Electricity in Mines.

There is still considerable prejudice against the use of electricity in mines in which there is any possbility of explosion and explosions are probably ascribed to its use, which have been caused by other means. A report which has just been published in England by the Chief Inspector of Mines on a recent colliery explosion is therefore specially interesting and important, because of its bearing on the use of electricity in coal mines. The Inspector states: "I am perfectly satisfied that the use of electricity in the mine had no bearing on the disaster." That expression of opinion is perfectly definite and although it must not be read as absolving electricity from being a source of risk under any circumstances, it should go far to reassure those engaged in mining who express the view that the electric switch at the conveyor is a weak point in the system.

Every section of the community stands to benefit by the more extended adoption of electrical and mechanical means of hoisting and handling coal in mines, but of all sections the mines themselves stand to gain most.

A very large proportion of the men are strongly prejudiced against its use and two main reasons may be suggested to account for it. Of the various mechanical aids electricity has become in the minds of the men associated with danger, mainly it would appear, through ignorance. The only satisfactory way of meeting the miners' objection to electricity on this score is so to apply and use electricity that only culpable carelessness on his part, or some extraordinary accident to the apparatus can put him in any danger. That this is possible there is no doubt whatever. The miner's other objection to electrical machinery is economically unsound; they are under the impression that electrical coal cutting will deprive them of work. Precisely the same difficulty occurred when machinery was introduced into other industries. It is to be regretted that the electric coal-cutter and belt conveyor should be fought with a bitterness which is not explained by any new element of danger which they introduce.

Some eight years ago a committee was appointed in England to inquire into the means of securing the utmost possible safety for electrical working of coal mines, as that is the first essential condition to be established and the existing regulations were drawn up. The progress of invention and manufacturing methods, together with modifications in practice suggested by experience, resulted in the nomination of a second committee eighteen months ago, which published a report recently and suggested several modifications of the existing regulations. The committee states that as the result of their inquiries they ascertained that although the accidents and ignitions arising from the general use of electricity were on the increase, yet in view of the great increase in electrical plant, the risks attending the use of electricity in mines were decreasing and that in no year had the fatal accidents due to the introduction of electricity been greater than 1.54 per cent of the total fatal accidents. The risks associated with the use of electricity may be classified as due to either shock or ignition. There are two ways of attacking the shock problem; one is that of employing such a low pressure that the shock would seldom be dangerous, and the other is that of employing only properly protected apparatus. For all fixed plant the latter is the better and indeed the only safe method, while for portable plant complete protection should be aimed at, but having regard to the inherent difficulties in the way of totally preventing contact with live parts, it is advisable to adopt a low pressure as a further safeguard. In the case of fixed plant adequately protected, the question arises as to whether any limits should be set to the pressure under which it should operate. Many electrical engineers think that there should be a limit and a fairly low limit and ten or even five years ago there was considerable justification for such a view, for at that time high-tension cables and apparatus had not been as thoroughly developed as they have been since, and moreover not much attention was then paid to the special requirements of colliery electrical apparatus. In the report referred to above the committee stated very definitely that they saw no reason why a high-tension system should not be as safe as regards risk of shock and explosion as a medium, or low-pressure system. The adoption of higher pressures is moreover accompanied by some substantial benefits. As is well known, a high-presure cable is thinner and lighter and more easily handled and supported than a low-pressure cable of the same power and it is generally of the highest class of construction and provided with extra thick insulation.

Extension of Electric Drive in Flour Mill.

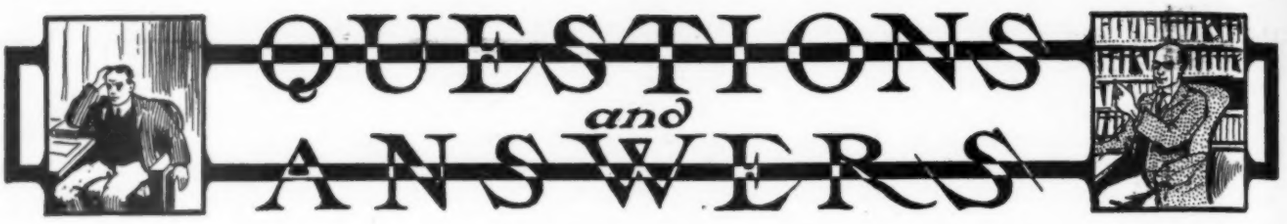
Recent extensions and improvements in the power equipment of the Pillsbury Flour Mills, Minneapolis, Minn., have included, among other things, a more general application of electric drive to their milling operations—a feature possessing many obvious advantages for this particular industry. To meet this additional electrical load, their central station has been similarly modernized, the latest accession comprising a 2,000-kilowatt Westinghouse turbine of the familiar high-speed, double-flow construction, employed by the builders for units of this capacity and above.

The condensing equipment has also been augmented by the addition of a Le Blanc barometric-type condenser; conditions at the Pillsbury plant being particularly favorable to the barometric construction, as opposed to the standard low-level Le Blanc condenser usually furnished. The vacuum maintained, will range from 28 to 29 inches, depending upon the temperature and quantity of cooling water used.

The turbine is to drive a generator, normally rated at 2,500 kilovolt-amperes delivering three-phase, sixty-cycle current at 2,200 volts.

Important Hydroelectric Plant in Cuba.

From reliable sources it is learned that an important hydroelectric plant is to be constructed in Cuba in order to supply current for a new line of electric railways to be built to connect Cienfuegos with Cruces, Manicaragua, Santa Clara, Camiguani, Tunas, Fomenta, Sagua, and Caibarien. For this purpose the Habanilla water falls, north of Cienfuegos, and other water powers in the neighborhood of the town of Trinidad, are to be utilized.



All readers of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN are invited to submit questions and answers to this department. Correspondents are requested to send full name and address. This, however, will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered.

Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office not later than ten days after the date of publication of the question. Answers will be published in a subsequent issue.

QUESTIONS.

No. 3.—ROTATION NEAR ALTERNATING-CURRENT MAGNETS.—When two metal disks, mounted on pivots so that they overlap and are free to turn, are held over the pole of a magnet excited by alternating current, the disks rotate in opposite directions. Will you explain why this rotation takes place, and why one disk is affected differently from the other?—H. C., Evanston, Ill.

No. 10.—ELECTROMAGNET DESIGN.—What is the smallest sectional area of core of an electromagnet which will be sufficient to exercise a force of one pound upon any armature two inches away, and what winding should be used? It is to be connected to a 110-volt circuit and used intermittently.—M. E. R., Baltimore, Md.

No. 12.—"STRIP" FOR DISPLAY ILLUMINATION.—In the account of the British coronation illuminations that appeared in your issue of July 22, mention was made of the use of "strip" for outline lighting. Please explain what this "strip" material is and just how it is used.—S. J., New Orleans, La.

No. 13.—AUTOMOBILE IGNITION SPARK COIL.—Please give sketch and information on a low-tension spark coil to be used in connection with the make and break ignition system of a six-cylinder automobile to be operated on six volts.—S. L. K., Reading, Pa.

No. 14.—ELECTRIC LIGHTING OF PULLMAN CARS.—The Pintsch gas lighting of railway cars is to some extent being superseded by electric lighting. Please explain the modus operandi with reference to the electric generator and accumulators. What is average size in kilowatts of generator and accumulators? What is the efficiency of generator and accumulators? When the generator is working at its highest efficiency, speaking of one Pullman car, what impedance does same offer to the free movement of a train of passenger cars, considering continual side belt strain on axle bearings, magnetic drag, weight of equipment and the like? At what speed of a train, in miles per hour, is the greatest demand of the generator on the free movement of the train, and what is the energy required in horsepower?—H. W. F., Chattanooga, Tenn.

No. 15.—TWELVE-HUNDRED-VOLT DIRECT-CURRENT RAILWAYS.—I understand that 1,200 volts is now used on a numbe of direct-current interurban railways. Is it possible to arrange the car wiring so that such a car may enter a city on the ordinary 600-volt trolley lines? If so, how is this done?—N. H. La Salle, Ill.

No. 16.—OZONE AND ELECTRIC OZONIZERS.—Is the use of ozone a truly effective means of purifying the air in a large hall or theater, or is it merely an adjunct to the regular ventilating system? Is an electric ozonizer the best apparatus for preparing ozone in large quantity, such as for the service referred to?—E. K. T., Iowa City, Ia.

ANSWERS.

No. 1.—LAMP-COLORING FLUIDS.—Please tell me the formulas for the fluids used in coloring incandescent-lamp bulbs red, green, orange, blue, etc.—W. B. L., Wallingford, Conn.

At various times I have made coloring fluids with more or less success. The best results were obtained with a collodion solution to which a small quantity of aniline dye of the desired color was added. This has to be well corked or it evaporates quickly. It is cheaper to use thin shellac instead of collodion, but the color film cracks quickly. I have tried a solution of water-glass with water-soluble aniline dyes, but it was not very uniform, possibly because it was too thick. Have heard of using gelatine, but found it too thick for the purpose. Lately I have bought my coloring fluids from a New York house and find this cheaper and better than trying to make them myself.—J. M. P., Troy, N. Y.

No. 4.—CHANGING GASOLINE CAR TO ELECTRIC.—Please tell me whether it would be practicable to change a single-cylinder runabout to an electric. The engine is claimed to be ten horsepower and is very noisy. The running gear and body of the car are in good condition; the chain drive could probably be used again. There is ample room under the seat for the battery. What size battery and motor would be required for a rig of this kind? What would be the cost of each and of a controller? We have a little shop and could make the change-over, if the electrical parts did not cost too much.—W. R. S., Ellsworth, Kans.

It would be inadvisable for you to change your gas car into an electric for the following reasons: (1) The parts of your present car that would be serviceable in an electric vehicle are not the most expensive parts required. For instance, in an electric vehicle selling, say, at $1,000, the respective value of the different parts is as follows:

Battery	$ 350
Motor	125
Voltmeter and ammeter	50
Wiring, lamps, switches gongs, etc.	35
Controller with rheostat	25
Car body with overhead top	115
Chassis with four wheels	275
Extras	25

(2) The springs supporting the car body, which you now have, are not designed with sufficient strength to support the necessary weight of the motor and battery, which would approximate 650 pounds. (3) You can purchase in any large city in which electric vehicles abound a good second-hand electric at a cost not exceeding one-fourth that of the new electric parts to fit up your gas car, and thus save yourself considerable time and expense and at the same time have a much better guarantee of serviceability than by reconstructing your gas car.—A. B. D., Wilkes-Barre, Pa.

No. 6.—VERTICAL AND HORIZONTAL TURBINES.—What are the relative advantages of vertical as against horizontal steam turbines for driving genera-

tors? Why are the vertical machines not made in small sizes?—R. B., Milwaukee, Wis.

The only undisputed advantage of a vertical turbine over a horizontal one is that it is slightly more economical of ground space, since the generator is superposed on the turbine; this saving of space is at the expense of other features, however, and is scarcely worth its added cost. On the other hand, the horizontal turbo unit is more accessible, more logically arranged with the generator removed from the heat of the turbine and much more readily and effectively ventilated. Moreover, it does not require such care in setting up and balancing, nor such constant and skilled attention to its bearings as the step-bearing of a vertical machine needs. Since the small plants cannot afford so many nor such skilled operators as the very large ones, the use of step-bearings and therefore of vertical machines is practically out of the question for small sizes.—W. C. N., Pittsburg, Pa.

No. 11.—Tungsten and Arc Lamps in Series.—Is it possible to install tungsten lamps on series circuits on which arc lamps are also being used? What precautions are necessary?—W. M., Sheboygan, Wis.

Series arc lamps and incandescent lamps can be used satisfactorily on the same circuit providing both kinds of lamps are rated at the same current. In many towns where arc lamps have been customary, tungsten lamps are being installed on the same circuits during the gradual transformation to this type of lighting. In this way the smaller units can be used and the lamps be placed at lesser intervals. No trouble has been experienced in this city where the arc lamps were rated at 6.6 amperes and the tungsten lamps were ordered for the same rating.—G. M. W., Goldfield, Nev.

It is possible to install tungsten lamps in series circuits with arc lamps, and there are a number of such circuits in successful operation. The life of the incandescent lamps should not be shortened over five per cent, if the regulation of the circuit is good. If, however, the circuit becomes overloaded, the increase in currnt will burn out the filament. If such a condition is probable, it would be advisable to install with the tungsten lamp an overload release device, to cut the lamps out of circuit until normal current conditions prevailed.—A. D. C., Schenectady, N. Y.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

MASSACHUSETTS ELECTRIC COMPANIES.

The statement of the Massachusetts Electric Companies for the June quarter and the fiscal year ended June 30 shows comparative results as follows:

	1911	1910
Quarter ended June 30—		
Gross	$2,293,622	$2,130,957
Operating expenses	1,410,089	1,340,168
Net	$ 883,533	$ 790,788
Charges and taxes	462,234	418,237
Balance	$ 421,298	$ 372,551
Year ended June 30—		
Gross	$8,881,520	$8,447,062
Net	3,324,217	3,230,494
Charges and taxes	1,838,330	1,765,799
Balance	$1,485,886	$1,464,695

CUMBERLAND TELEPHONE & TELEGRAPH.

The report of the Cumberland Telephone & Telegraph Company for the month of June and six months ended June 30, 1911, compares as follows:

	1911	1910
June gross	$ 606,027	$ 565,162
Expenses	356,844	319,407
Net	249,183	245,755
Charges and taxes	50,044	48,221
June surplus	199,139	197,534
6 months' gross	3,595,354	3,366,009
Expenses	2,127,824	1,916,044
6 months' net	1,467,529	1,449,965
Charges and taxes	307,036	287,532
6 months' surplus	1,160,493	1,162,433

NORTHERN OHIO TRACTION.

The report of the Northern Ohio Traction & Light Railroad Company for month of June and six months ended June 30, compares as follows:

	1911	1910
June gross	$ 245,097	$ 221,673
Expenses	134,983	123,125
June net	110,114	98,548
Charges	44,333	43,375
June surplus	65,781	55,173
6 months' gross	1,222,676	1,087,335
Expenses	697,023	624,250
6 months' net	525,653	463,105
Charges	267,107	259,916
6 months' surplus	259,545	203,188

MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company for the month of June and nine months ended June 30 compares as follows:

	1911	1910
June gross	$ 430,026	$ 384,564
Expenses	227,217	198,349
June net	204,809	185,715
Charges and taxes	63,996	54,940
June surplus	140,813	130,776
9 months' gross	3,438,940	3,091,799
Expenses	2,015,139	1,806,292
9 months' net	1,423,801	1,285,508
Charges and taxes	63,996	54,940
9 months' surplus	1,019,915	924,420

PHILADELPHIA COMPANY.

The report of the Philadelphia Company and affiliated corporations for the month of June compares as follows:

	1911	1910
June gross	$1,557,660	$1,681,626
Expenses	1,020,065	944,400
June net	537,595	737,226
Other income	199,072	183,185
Total income	736,667	920,411
Charges	590,633	576,592
June surplus	146,034	343,819

DETROIT UNITED RAILWAY.

The report of the Detroit United Railway Company for the month of June and six months ended June 30, 1911, compares as follows:

	1911	1910
June gross	$ 893,250	$ 831,472
Expenses	563,512	512,996
June net	329,737	318,476
Other income	16,478	12,436
Total income	346,215	330,912
Charges and taxes	177,178	168,530
June surplus	169,037	162,381
6 months' gross	4,768,049	4,344,067
Expenses	3,026,290	2,770,784
6 months' net	1,741,759	1,573,282
Other income	85,451	74,068
Total income	1,827,210	1,647,351
Charges and taxes	1,057,277	973,057
6 months' surplus	769,932	674,293

NASHVILLE RAILWAY & LIGHT.

The report of the Nashville Railway & Light Company for the month of June and six months ended June 30, 1911, compares as follows:

	1911	1910
June gross	$157,570	$157,426
Expenses and taxes	94,056	91,576
June net	63,514	65,851
Depreciation and preferred dividend charges	48,989	48,769
June surplus	14,525	17,082
6 months gross	952,118	887,953
Expenses and taxes	564,045	516,589
6 months net	388,073	371,365
Depreciation and preferred dividend charges	292,191	291,195
6 months' surplus	95,882	80,170

BINGHAMTON RAILWAY.

The Binghamton Railway reports for the year ended June 30, 1911, compared as follows:

	1911	1910
Gross	$372,211	$349,186
Net	159,684	148,933
Surplus	48,904	40,505

General Electric Company's Business.

General Electric's business has fallen off slightly the past two months, as is usual during the summer. Orders for large work are scarce, thus forcing the company into the field of smaller product. Demand for electric fans this summer has been unprecedented, this helping to keep the plants of the company operating to a fair percentage.

Although the earnings of the General Electric Company would warrant an increase in dividends, it is not likely that this will be done. With industrial conditions as they are at present, officials feel that it would be injudicious to increase payments on the stock. Present trust legislation also has a great deal to do with this.

There have been several of the subsidiaries including the Sprague Company taken into the company more fully, so that the earnings will appear with those of the parent company. Heretofore the latter has controlled by stock ownership alone.

Since the patents held jointly by the General and Westinghouse companies have expired, each company is working independently of the other.

New Electrical and Mechanical Apparatus and Appliances.

A Thermometer Invention.

A thermometer for the indication of exceedingly fine differences in temperature and hence termed a micro-thermometer, has been invented by Louis V. King, of McGill University (Canada). The principle underlying the thermometer is that variations in the resistance of a coil of wire serve to indicate the changes of temperature of the medium in which the instrument is immersed. The coil has a resistance of 125 ohms. It consists of 250 feet of pure iron, silk-covered wire wound on a copper cylinder. The thermometer is specially designed for the measurement of temperatures on the side of a vessel and consequently the coil of wire is inclosed in a second copper cylinder and the whole is made water tight.

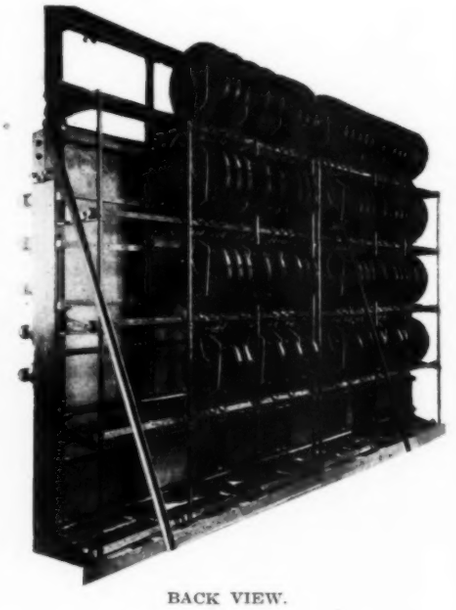
Use of this thermometer has been made in detecting the approach of icebergs. Up to the present time the method of taking temperatures has been to dip water up out of the sea and test as quickly as possible. This means that continuous measurements cannot be taken. With the new invention, however, by attaching an instrument similar in action to the oscillagraph a continuous curve is drawn and the slightest changes in temperature can be instantly noted.

Large Dimmer Equipment for Russian Theater.

The accompanying illustrations show the front and back view of a dimmer bank recently shipped from the factory of the Cutler-Hammer Manufacturing Company, of Milwaukee, to St. Petersburg, Russia. This bank consists of fifty-four dimmers or sixty-eight plates but is designed for a total capacity of 140 dimmers, 172 plates. The dimmers are arranged in an I-beam frame work and driven from operating levers mounted in another frame work. One shaft for controlling each color (white, red, blue and green) is provided and an extra one for the orange lamps that will be added later.

One unique feature is the use of sheet-steel panels instead of marble switchboard panels. This makes unnecessary the use of wooden switchboard templets and makes shipping easier. The hand-wheel shown at the bottom of the front view, moves the two rods vertically in opposite directions through worm-gear and bell cranks. The master levers may be set so as to interlock with either of the rods, dimming or brightening as desired. Dimming of one color and brightening of another can be accomplished noiselessly, conveniently and with fine variations of lamp brilliancy. For further convenience each dimmer plate is provided with its own individual operating lever. Master levers for handling all plates of any color are also provided. Cutler-Hammer "Simplicity" type dimmers have been installed in several European countries during recent years, displacing the water-rheostat dimmers and other large resistance banks that have been in use on the Continent.

FRONT VIEW.



BACK VIEW.

New Substation Apparatus.

The North Side Hydro-Electric Company, subsidiary to Caroline Power & Light Company, which is to distribute the Blewett Falls energy, has purchased from the General Electric Company, for its switching and substation at Method, four 2,750-kilovolt-ampere single-phase transformers for stepping the voltage down from 100,000 to 60,000 volts, with complete equipment of switches, etc., also three 1,250-kilovolt-ampere single-phase water-cooled transformers for Henderson substation, for stepping the voltage from 60,000 to 22,000 volts for distribution at Henderson.

The above includes a complete switchboard and miscellaneous equipment for the Henderson substation.

ABolites.

W. C. Hine of Cleveland, O., who for many years has been prominently identified with the development and manufacture of lighting fixtures, has recently developed and patented a line of Universal holder sockets. In a word, the holder socket is a simple unit taking the place of socket, shade holder and, at the same time, performing the function of a fixture for single-unit illumination.

The Adams-Bagnall Electric Company, of Cleveland, has secured from Mr. Hine an exclusive license to manufacture and sell the line.

CROSS SECTION OF PENDANT ABOLITE

This company has applied the principle to commercial and industrial lighting units and is manufacturing and selling them under the trade name, "ABolites." A short outline of characteristic features will undoubtedly be of interest.

To obtain scientific illumination, it has always been necessary to obtain proper relation between lamp and reflecting surface. On account of different lengths of bases in Mazda lamps, it has been necessary to attach several kinds of separable holders to a regulation Edison socket. The reflector in turn was suspended from the holder.

25-WATT BOWL TYPE.

The primary construction characteristic of the ABolite is the provision of a metal support for a reflector to replace variable holders. To this is applied the cardinal principle of a patented positioning device attached to a suitable porcelain receptacle. When the positioning yoke is thrown downward, the lamps and reflector are in the position obtained by use of "O" holder. When thrown upward, the "H" position is obtained. These two positions or intermediate ones are possible in ABolites designed for reflectors with 2.25-inch fitters, that is for lamps of 25 to 100 watts inclusive.

250-WATT EIGHTEEN INCH DOME.

The same principle applies to reflectors with 3.25-inch fitters, i. e., 150 to 500 watts inclusive. Two pendant (2.25 and 3.25-inch) and two ceiling (2.25 and 3.25-inch) ABolites take care of practically all single-light illumination requirements on all lamps 25 watts to 500 watts inclusive. This obviates the necessity of carrying a large and diversified stock of lighting fixtures and accessories.

CEILING ABOLITE.

A complete industrial "ABolite" is made up of two parts, the universal holder socket and the scientifically designed steel reflector. The following table outlines the salient features of the industrial "ABolite," (1) positioning device provides for O, H and A positions; (2) eliminates all separable holders; (3) one holder socket universal for all lamps, 25 watts to 500 watts inclusive; (4) all weight suspended from holder socket itself; (5) reflector removed for cleaning without breaking any wire connections or disturbing the holder socket already in place; (6) intensive and extensive illumination obtained with the same "ABolite" by simply changing positioning device; (7) larger or smaller units can be substituted for those in place without touching the holder socket already in place.

500-WATT BOWL TYPE.

In connection with this line, the Adams-Bagnall Electric Company has established a department of "Efficiency Engineering" for the purpose of studying industrial conditions and co-operating with industrial managers in bringing their illumination to a plane where labor efficiency and factory output will be greatly increased.

60-WATT BOWL TYPE.

The work of this department is part of the general efficiency movement just launched, and the initiative taken by this company in the establishment of such a department will do much toward improving general industrial-lighting conditions.

Copper-Clad Wire.

The commercial value of copper-clad steel wire for telegraph service was brought out in a report of Frank F. Fowle, consulting engineer, under date of June 1, 1911, to the Duplex Metals Company, of Chester, Pa. Copper-clad steel wire for telegraph service can be considered almost exclusively with reference to the closed-circuit Morse system, manually operated, which is employed in America far more extensively than any other.

PENDANT ABOLITE.

This system as a whole embraces three kinds of transmission, simplex, duplex and quadruplex. The require-

ments for line conductors in each case are not alike owing to differences in operating currents, relay types and battery arrangements, but under average commercial conditions the duplex requires less conductivity than the simplex and the latter less than the quadruplex.

The basic requirements for commercial transmission are twofold: First, the strength of signals must be sufficient to operate the relays firmly and rapidly; and, second, the speed must be fully equal to the highest rate of hand-sending.

Every telegraph circuit possesses the following electrical properties, combined in different relative magnitudes according to the type of construction: (1) resistance, (2) inductance, (3) capacity, (4) leakage.

Lines of open wire have more or less resistance, according to size and material. Their inductance is negligible for present purposes and the capacity is comparatively low. The leakage, however, varies greatly with the state of the weather.

The strength of signals is dependent almost entrely on the resistance and the leakage, but the speed is limited by the capacity. In cable transmission the effect of capacity is very prominent, while the leakage is practically nothing; but in lines of open wire the situation is reversed, and the small amount of cable ordinarily present does not materially affect the case. Here the leakage fixes a much lower limit of transmission distance than capacity, and strength of signals rather than speed becomes the main consideration.

An increase in either resistance or leakage decreases the efficiency, and conversely an increase in conductivity or insulation resistance increases it. Within approximate limits, the efficiency remains unchanged so long as the product of resistance and leakage conductance is the same, or constant.

Uninterrupted service is commercially essential, and as the most severe conditions are imposed by the maximum degree of leakage only the minimum value of insulation resistance need be considered. This varies somewhat according to locality and the type of insulators employed, but a safe average minimum is one-fourth of a megohm per mile.

The normal operating current in a telegraph line is about fifty milliamperes, for simplex transmission. When the line is fairly well insulated, as in dry weather, the minimum current is practically nothing. In this case the relays operate on a margin substantially equal to the full operating current. But as soon as any leakage appears the minimum current commences to have an appreciable value, and increases with the leakage. At the same time the margin decreases, and with it the force which operates the relays. The limit is reached at the lowest safe margin for commercial operation of the relays.

Assuming that the minimum insulation resistance is one-fourth of a megohm per mile, and taking the operative characteristics of 150-ohm standard relays, the operative limits of distance with line wires of different resistances are given in the table below, for simplex transmission.

Resistance Per Mile of Wire in Ohms.	Limit of Distance in Miles.
2	597
3	510
4	450
6	376
8	331
10	299
15	248
20	217
25	195
30	179
40	156
50	140

Taking the weight of the mile-ohm at sixty-eight degrees Fahrenheit, as 895 pounds for hard-drawn copper, 2,075 pounds for copper-clad steel and 5,600 pounds for B. B. iron, the resistance per mile and the operative limits for various sizes are those given below.

Gauge.	Copper. (B & S)		Copper Clad. (B & S)		B. B. Iron. (B. W. G.)	
No.	Ohms.	Miles.	Ohms.	Miles.	Ohms.	Miles.
6	2.13	585	5.32	397	9.49	306
7	2.69	535	6.72	358	12.10	274
8	3.39	485	8.47	322	14.36	255
9	4.28	437	10.70	290	17.84	229
10	5.39	395	13.47	261	21.71	209
11	6.78	357	17.00	235	27.19	187
12	8.61	321	21.40	211	32.94	172
13	10.81	289	26.94	188	43.40	150
14	13.64	260	34.02	169	56.55	...

It would be possible, however, with higher insulation resistance, to increase the wire resistance without cutting down the distance. For example: the limit of a four-ohm wire is 450 miles, but with an insulation of one-half megohm per mile an eight-ohm wire would operate the same distance; and with one megohm a sixteen-ohm wire would suffice.

The natural field for copper-clad steel will appear from the following table of estimated first cost and annual charges, per mile of wire. The base price of copper has been taken at 13.5 cents per pound, copper-clad at 11.95 cents net, and B. B. iron at 3.25 cents. Allowances have been made for the cost of stringing, and for the scrap value of copper and copper clad. The life assumed for copper and copper clad is fifty years, and for iron twenty years.

	First Cost.			Annual Charges.		
Gauge No.	Copper. (B & S)	Copper Clad. (B & S)	Iron. (B. W. G.)	Copper. (B & S)	Copper Clad. (B & S)	Iron. (B. W. G.)
6	$65.66	$55.49	$27.61	$6.05	$5.76	$4.36
7	53.83	45.74	23.48	5.17	4.94	3.87
8	44.44	38.04	21.11	4.47	4.29	3.58
9	37.24	32.11	18.64	3.94	3.79	3.29
10	31.33	27.25	17.14	3.50	3.38	3.11
11	26.82	23.51	15.38	3.17	3.07	2.90
12	22.94	20.44	14.38	2.88	2.81	2.78
13	20.21	18.16	13.27	2.68	2.62	2.64
14	17.79	16.16	12.39	2.50	2.45	2.54

General experience shows that copper smaller than No. 9 B. & S. is unreliable mechanically. This size has an elastic limit of about 210 pounds and a tensile strength of about 620 pounds. But No. 12 B. & S. copper clad has an elastic limit of approximately 250 pounds and a tensile strength of 510 pounds.

While copper clad is the most economical conductor for lines shorter than 300 miles, it has a higher resistance than copper and in comparison requires a higher voltage for operation. But after due investigation it will be found that the increase in cost for higher voltage of supply is much less than the saving in annual charges on the line wire.

The range of economical use for copper clad can be extended in two ways. First, wherever automatic repeater stations can be installed near the middle of the line, the range can be increased to more than 500 miles, or nearly doubled, for less annual expense than a straight circuit of mechanically safe copper. Second, by the use of more efficient insulators, so as to decrease the leakage, the range can be extended even farther.

New Condensing Equipment.

A development of considerable importance in its bearing upon large central-station work, is to be noted in a recent order placed with the Westinghouse Machine Company, which included a No. 20 twin-type Le Blanc condenser. This unit which is simply a combination of two No. 20 standard Westinghouse Le Blanc outfits, is equipped with two sets of air and circulating pumps mounted on a common shaft. Couplings at each end of the latter provide for either turbine or motor drive. The condenser is designed to handle approximately 8,000,000 pounds of water per hour, and will operate in connection with a 12,000-kilowatt turbine in the Manchester Street plant of the Rhode Island Company, Providence, R. I.

The Electro-Bessemer Furnace.

The Electro-Bessemer furnace shown diagrammatically in the accompanying illustrations combines in principle the cheap and rapid operation of the ordinary Bessemer furnace, while the disadvantages of lack of uniformity is entirely overcome by applying the electrical process of final refining.

The Electro-Bessemer furnace is a closed vessel, having an opening in one side, through which the charge may be introduced and slags added and withdrawn. It is mounted on bearings of ample size, and is capable of beng tilted within an angle of rather more than 180 degrees, the motive power being either electric or hydraulic, with suitable gearing interposed. One end of the furnace is fitted with blast tuyeres for blowing. At the other end of the

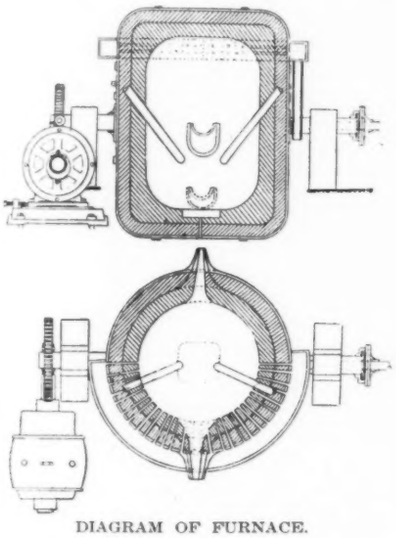


DIAGRAM OF FURNACE.

vessel electrodes are arranged, entering through the furnace wall, and being adjustable by any of the ordinary independent methods—either electrical or mechancial. A tapping hole is provided at this end of the furnace, which may be used for the removal of the finished product, if desired. Samplings may be taken from the charging opening, which opening might also be used, if desired, for pouring the molten metal. The electrodes are fitted with cooling jackets of cold air or water.

The process is simple in the extreme, being briefly as follows: The furnace is pre-heated in the ordinary way, and is then charged with molten metal direct from a cupola or blast furnace mixer, the furnace being tilted into an horizontal position. It is then brought to a vertical position, the "Bessemer" portion containing the charge. The blast comes into action automatically as this position is gained, and the process of conversion proceeds as in the ordinary Bessemer converter. Meantime, the "Electric" portion of the furnace is heated by the hot gases, etc., resulting from this process, and for the ultimate removal of which gases ample provision is made. On the completion of this part of the process the furnace is tilted, and the metal transferred to that end which is provided with electrodes. Current is switched on, and the refining operation continued to any desired extent. Both arc and resistance heating are obtained in the furnace.

It will therefore be seen that by means of this invention the trouble, expense and loss of heat arising from the transfer of molten metal to the electric furnace in the ordinary duplex process of refining blown Bessemer metal electrically is saved.

The Electro-Bessemer furnace may be either basic or acid lined; if it is basic lined it is possible to start with impure basic Bessemer pig-iron, and to produce a finished steel of better analysis than the best acid open-hearth steel. If the furnace has an acid lining, chemical refining of the blown metal will not take place, but the killing of the metal by heating in the "Electric" end of the furnace results in the production of particularly sound castings and ingots free from blow-holes. The average specific energy consumption is well below 200 kilowatt-hours per ton of steel produced. Verdon, Cutts & Hoult, Sheffield, Eng., are the makers.

Western Electric Switchboard to Be Installed at West Point Military Academy.

The Western Electric Company recently sold to the United States Government a complete central-battery exchange equipment to be installed at West Point, New York. This equipment consists of a multiple switchboard with a capacity of 3,000 common-battery lines, together with frames, racks, a complete power plant and 25,000 feet of paper-insulated, lead-covered underground cable. In addition to this, the contract calls for all the necessary telephone sets, protectors, outside distributing wire and the installing and connection of the underground cable.

This switchboard, which will serve all the territory covered by the Military Academy and the United States Army Post, will be equipped for long-distance connection. Toll lines will connect with the New York Telephone Company's office at Newburgh. Telephones will be installed in the officers' quarters, stores, all the academy buildings and executive offices. It is interesting to note that men operators will be employed.

New Holophane Advertising Book.

"Ad-Hints," a little booklet of advertising inspiration, is the title of a pamphlet recently issued by the Holophane Company, of Newark, O., for

Is your house *really* lighted from top to bottom or do you still have to take a candle or lamp when you go to the attic or cellar at night?

A great many people who have electricity in the rest of the house have no light in cellar or attic because it is seldom needed, but—when you do need it you need it badly.

One incandescent lamp set in a Holophane Reflector will give sufficient light for the darkest cellar or attic. Holophane Reflectors are especially adapted to lighting places of this sort as they control the light rays so that every ray is utilized. Wouldn't it be a convenience if you could turn a switch and light your cellar or attic before entering? That means an end to dangerous matches and flames—it means that you no longer need stumble against misplaced boxes and bark your shins in the dark.

We would like to tell you more about electric lighting and more about the wonderful light-saving Holophane Reflectors. May we send a representative to see you?

(Imprint)

Newspaper Ad No. 39
Holophane Company

Type used—24 pt. Caslon Old Style
12 pt Scotch Roman

SAMPLE ADVERTISEMENT.

distribution among central stations and contractors to be used as suggestions for their local newspaper advertising.

The book contains ten electric lighting advertisements, with appropriate cuts, and is prefaced by a number of short, pithy ad-hints, such as: "If you want to know how bad your company's advertisements are, read two or three of them aloud to your 'best girl,' or the chauffeur, or a foreigner, or try to explain them to the baby. However, do not try this experiment unless you are feeling very, very strong."

The advertisements which were prepared by the Rae Company, each deal with the lighting of some part of the home, from the front porch to the garage or barn, and are arranged for either single or double-column display. The Holophane Company supplies electrotypes without charge.

New Equipment for Yadkin River Power Company.

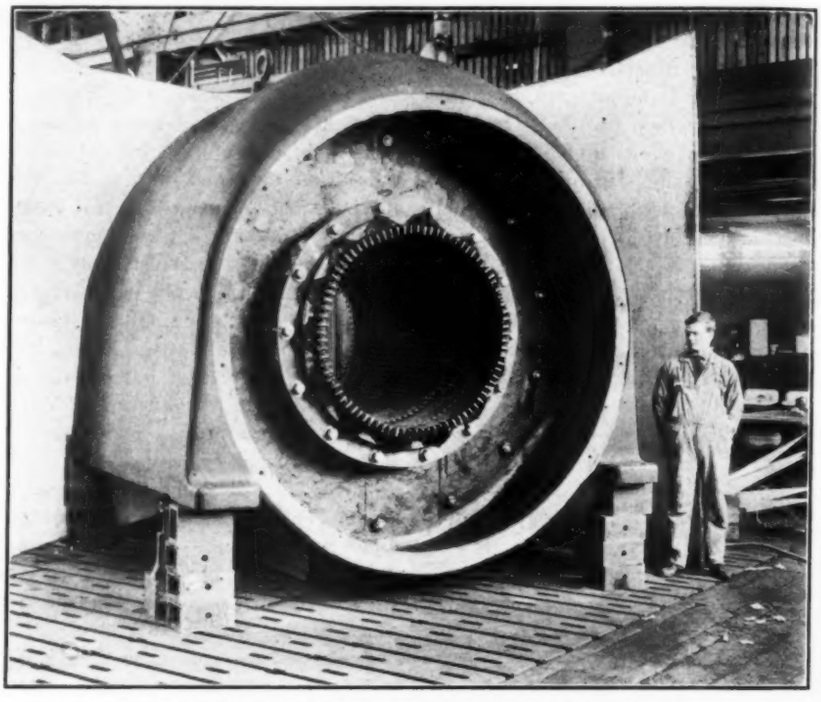
The Yadkin River Power Company has placed an order with the General Electric Company for three 6,000-kilovolt-ampere water-wheel driven 4,000-volt generators; five three-phase 6,250-kilovolt-ampere transformers, 4,000-100,000 volts, and four 2,500-kilovolt-ampere transformers, 4,000-22,000 volts.

The former transformers are for stepping up the generating voltage to the transmission-line voltage of 100,000, while the latter are for stepping up the voltage to 22,000 for local distribution.

The above apparatus is for use in the generating station at Blewett Falls on the Yadkin River. In addition to this apparatus, the order covers a large amount of switching and miscellaneous apparatus for complete 30,000-horsepower generating station.

A Large Turbo-Generator.

The accompanying illustrations give a good idea of a large turbo-generator which is being built by the Crocker-Wheeler Company, at Ampere, N. J., for the South Chicago plant of the Illinois Steel Company. This generator is rated at 3,400 kilovolt-amperes, 6,600 volts, twenty-five cycles, three phase. The weight of the stator is 92,000 pounds. At the high speed of rotation at which the generator operates the stresses produced in the windings and other parts are very great and special attention has been given to providing a large factor of safety to cover these stresses.



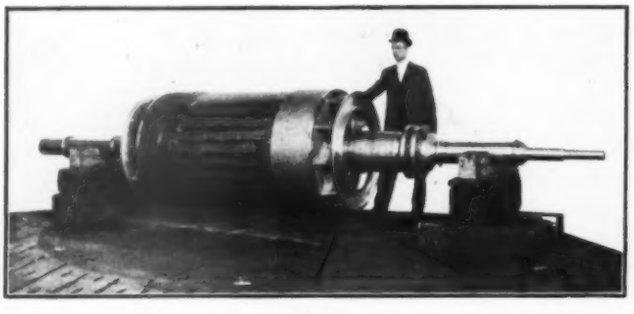
LARGE TURBO-GENERATOR-ROTOR REMOVED.

The matter of ventilation is extremely important, and special attention has been given to this. The high speed of rotation, however, materially assists in solving the ventilation problem. Special fans are provided at the ends of the rotor, these fans drawing the air current from the outside along the shaft into the rotor, the air being discharged through ventilating ducts. The air from the rotor passes through the stator ducts and through the heads of the stator coils into the stator where it is guided around the core in ample space and discharged below the turbo. This ventilation secures an unusually cool machine.

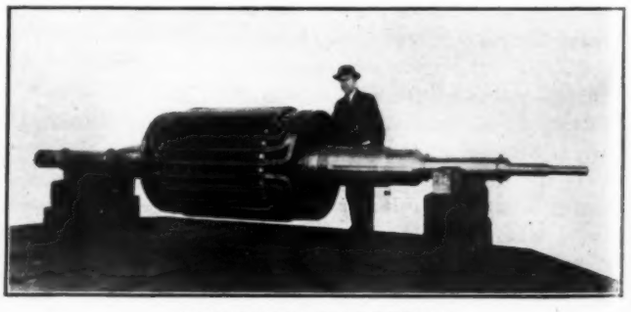
The rotor is provided with radial slots, although the conical shaped coils are more expensive than straight side coils which might be used with parallel slots. These conical coils consist of strip copper wound on edge in a special machine which automatically gives greater spread to the coil to each turn.

The core of the rotor is built up either of steel punchings or of nickel-steel disks, which give ample strength to this element. The ends of the rotor coils are protected by manganese-bronze rings, of which the fans are cast as an integral part. The slots are covered by manganese-bronze wedges in the higher-speed rotors and brass wedges in the lower-speed rotors. As a result the rotors are exceedingly strong and are subjected to a safe over-speed test in the shop before they are shipped. Great care is taken in balancing the rotor.

The stator coils are form-wound and placed in open slots, which are covered by wooden wedges. The large air-gap used in turbo-alternators makes it unnecessary to use the standard C-W magnetic bridges. The heads of the stator coils are securely fastened so as to withstand all strains due to short circuits. In every way these machines are of rugged construction for very severe service.



ROTOR.

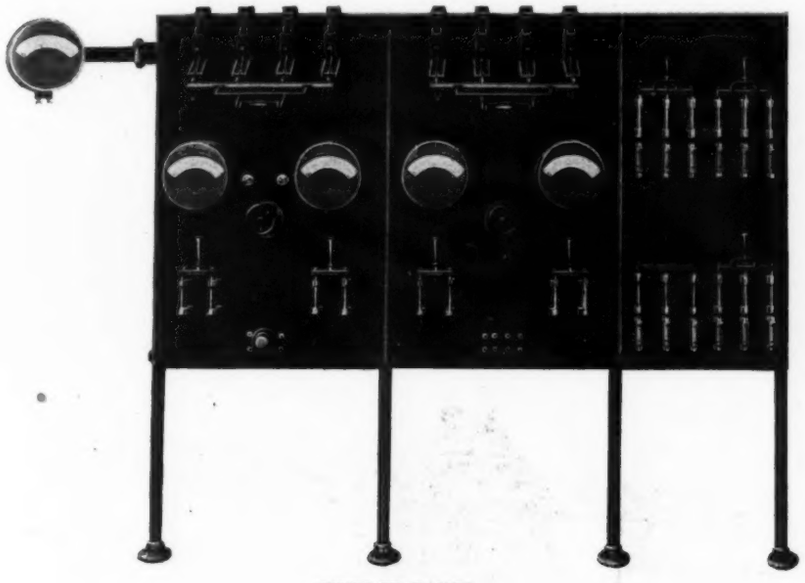


CHARACTER OF WINDINGS

Type JD Switchboards.

The type JD panels manufactured by the Westinghouse Electric & Manufacturing Company, are particularly adapted for the control of from one to three generators in small industrial plants or central stations operating low-voltage direct-current systems. The maximum capacity of a panel is 600 amperes and that of a board composed of these panels is 1,800 amperes, the number of panels being limited to five.

Each panel consists of a section of slate with a black marine finish, forty-eight inches high, varying in width according to the apparatus mounted thereon. The thickness of the slate is one and one-quarter inches for the two-wire panels and one and one-half inches for the three-wire panels. It is mounted on an iron frame built of one and one-quarter-inch gaspipe uprights, seventy-six and three-eighths inches high, fitting into ornamental floor flanges by which the board is secured to the floor. A wrought-ion strap is placed across the top of the board which insures the alinement and perfect rigidity of the panels. Wall braces may be secured to this strap at any point along the switchboard, a suitable number of wall-brace ends being furnished with each switchboard.



TYPE JD PANEL.

The two-wire switchboards are equipped with the well known type K meters up to 400 amperes capacity, above which size, type D ammeters are used.

Three-wire switchboards are equipped with the newly developed seven-inch-diameter type SL ammeters which are of the permanent magnet, open face, long scale type. Shunts for mounting on the generator frame are provided with the generator panel.

A type SL voltmeter on a swinging bracket is provided with each three-wire switchboard and each generator panel has an eight-point voltmeter receptacle by means of which the voltmeter may be connected to indicate the voltage of the generator or the voltage between the neutral and either side of the circuit.

In order to meet the special requirements of the Board of Fire Underwriters, and also to give as large a variety of arrangements of apparatus as possible, these panels are supplied with automatic protection as follows: two-wire generator circuits; (a) single-pole type CC carbon circuit-breakers or (b) inclosed fuses mounted on the front of the panel.

Two-wire feeder circuits; (a) single-pole type CC carbon circuit-breakers, (b) inclosed fuses mounted on the front of the panel, (c) inclosed fuses on slate bases, mounted on brackets on the rear of the panel.

Three-wire generator circuits; by four-pole type CC carbon circuit-breakers (one pole in the positive, negative and two equalizer leads).

Three-wire feeder circuits; (a) two-pole type CC carbon circuit-breakers, (b) three single-pole type CC carbon circuit-breakers with a common-trip attachment, by which all poles are tripped when any one trip coil is actuated (this attachment permits the breaker to be used as a combination switch and overload circuit-breaker), (c) inclosed fuses mounted on the front of the panel, (d) inclosed fuses on slate bases mounted on brackets on the rear of the panels. An extra set of fuses is supplied with each panel equipped for fuses. The bus-bars are made of copper strap of suitable cross section.

The switches are all of the substantial Westinghouse standard knife-blade type either single or double throw according to the service.

Each panel is completely assembled at the factory and to simplify erection in the field a practical wiring diagram is supplied with each switchboard.

New Line of Vacuum Pumps.

The accompanying illustration shows a new vacuum pump, suitable for vacuum house-cleaning plants of both the stationary and portable types, also for all purposes requiring a positive, steady vacuum, which has been perfected and is being placed on the market by Leiman Brothers, 62 John Street, New York, N. Y.

NEW VACUUM PUMP.

The Leiman pump is claimed by the maker to be the only machine that takes up its own wear and hence after long usage will not leak. The pumps are constructed with curved wings held in position by centrifugal force, which are said to embody many inherent advantages. They may be operated by any available power, either water, gas, steam, electricity or wind. The Leiman pumps are made in seven sizes, and are guaranteed to maintain a vacuum of from one to twenty inches.

Electrically Driven Water Works.

Electricity has been substituted for steam in driving the pumps at the water works of Lyons, France.

A New Moisture-Proof Dry Battery.

Where considerable moisture is prevalent it sometimes happens that the cardboard cartons of dry cells absorb so much moisture that when the cells are placed side by side or on a metallic base, they become short-circuited. This causes them to run down and deteriorate quickly, thus necessitating frequent renewals and an attendant maintenance expense.

The Western Electric Company, realizing this, has recently placed on the market a new, moisture-proof dry battery. This cell has been designed especially for use in mine, railway and general telephone service where the batteries are subjected to moisture. The new cell has the same high efficiency, long life, high voltage and recuperative power which characterizes the standard "Blue Bell" battery. It differs from the standard cell in that the cardboard carton has been treated with a special impregnating compound which effectually prevents moisture from reaching the cell proper. This will give sufficient protection so that the life of the batteries used in damp places will be as great as that of the batteries used in any other magneto service under ordinary conditons.

Submarine Telephone Cable Between England and Belgium.

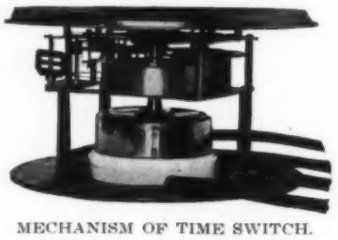
The telegraph and telephone authorities of England and Belgium have decided to lay a submarine telephone cable between these two countries. It will be 49.7 miles in length and will contain gutta percha for insulating material. The cable will be phantomed and loaded so as to provide four independent telephone circuits. The arrangement of the Pupin coils will be similar to that in the English-French cable laid last year. The contract has been awarded to Siemens Brothers, of London.

Reliance Automatic Time Switch.

The accompanying illustration shows the simplicity of the mechanism of the Reliance automatic time switch which is being placed on the market by Reliance Automatic Lighting Company, of Racine, Wis.

The Reliance switch is made in numerous types for controlling one, two or three circuits, of any standard voltage, alternating or direct current. All types are 10 by 10 by 5.5 inches in size and weigh about fifteen pounds. The makers state that only the best materials enter into the construction of these switches and a specially constructed eight-day clock mechanism with composition hair spring is used. The standard finish is brilliant black enamel, cast-iron case.

Some of the many uses for Reliance time switches are: To control show-window lighting; to control electric signs; to control show-case lighting; to control apartment house hall lights; to control motors running at predetermined periods; to control isolated street lights; to control burglar alarms, etc.



MECHANISM OF TIME SWITCH.

A Novel Freight Car.

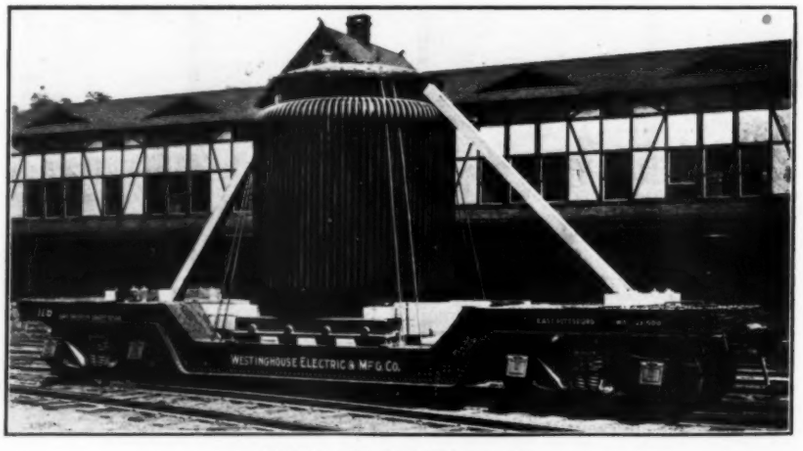
The car here illustrated is one of three of entirely new design, just delivered to the Westinghouse Electric & Manufacturing Company. This company has made it a practice to ship its large transformers completely assembled, ready for installation and immediate use on arrival at their destination.

The steady increase in capacity, size and weight of these transformers, rendered this mode of shipment more and more difficult, and special "cut-out" steel cars, with strong central floors suspended at about axle height from heavy side frames, were built for the Westinghouse Company some time ago. These cars had a capacity in the well of 70,000 pounds, but even they were inadequate for the dimensions of 2,000-kilowatt tubular transformers such as the one here shown, of which fifteen were ordered at one time by the Southern Power Company.

The new cars were built by the Atlas Car & Manufacturing Company of Cleveland, O.; the design is the joint product of co-operation between Westinghouse engineers and those of the car company, and the completed design had the approval of the Pennsylvania Railroad engineers.

The resultant car is entirely of steel, thirty-five feet five inches long, and has a capacity in the well of 150,000 pounds, or seventy-five tons. For a load that can be spread over the entire car, on the end platform as well as in the center, the capacity is 205,000 pounds. Notwithstanding this great capacity, the surfaces of the floor in the well is but two feet two inches above the top of the rails, giving a maximum amount of clearance under bridges.

The car frame is of heavy steel girders. The trucks have a capacity of 205,000 pounds, with journals six by eleven inches, thirty-three-inch wheels of rolled steel, and M. C. B. springs of extra large capacity. Center plates are wrought steel. Each car is equipped with Westinghouse air brakes, Westinghouse friction draft gear and M. C. B. automatic couplers.



SPECIAL TRANSFORMER CAR.

The transformer shown is of the oil-insulated, tubular self-cooling type, of 2,000-kilowatts capacity, sixty cycles, 101,200 volts, and is for the Southern Power Company's station at Newberry, S. C. As loaded on the car, the extreme top part of the transformer stood sixteen feet above the tops of the rails.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission, Second District, has received a complaint from the chamber of commerce of the Village of Gouverneur alleging that excessive rates are charged by the New York Telephone Company to its subscribers in that village. It is also stated that uniform rate for residences is not maintained and that a rate varying from $12 to $18 per year is charged for the same class of service. The Commission is asked to make an order requiring the company to maintain a residence rate of $12 per year and a business place rate of $18 per year.

The Public Service Commission, Second District, has authorized the New York, Westchester & Boston Railway Company to issue its first and refunding mortgage upon all its property, assets, etc., to secure an issue of gold bonds to the aggregate amount of not exceeding $60,000,000. The company is authorized to issue presently bonds to the amount of $20,100,000 to mature on the first day of July, 1946, and to bear interest at not exceeding five per cent. payable semi-annually. The proceeds of the bonds are to be used to refund at par the bonds of the New York, Westchester & Boston Railway Company, secured by its mortgage of October 1, 1904, to the amount of $16,200,000; to refund at par the principal of bonds secured by the first mortgage of the New York & Port Chester Railroad Company dated June 1, 1907, $100,000; for the purpose of acquisition of real estate and construction of the branch road of the company from Mt. Vernon to White Plains as previously authorized by the Commission, $3,800,000. The previous authorization of the Commission allowing the issue of $5,000,000 of bonds under the mortgage of October, 1904, is revoked.

A complaint has been received by the Public Service Commission, Second District, from the Board of Supervisors of the County of Orleans and the Board of Trustees of the Village of Albion protesting against the raise in rates by the New York Telephone Company in Albion and vicinity. The complaints state that the company has raised the telephone rental for business places from $2.00 to $2.50 per month and for residences from $1.00 to $1.25 per month, and that the service furnished is unsatisfactory and does not warrant the increase in rates. The complaint has been served upon the company and an answer required within twenty days.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The committee of the Illinois Legislature authorized to visit the states where public-utility commissions are exercising control over public-utility rates and service has been in Madison during the past week holding meetings with members of the Wisconsin Commission and investigating the work of the Commission. The members of the committee were especially impressed with the freedom of the Wisconsin Commission from political interference and were interested in the views of the members of the Commission as to the desirability of two commissions in Illinois. Mr. Roemer of the Commission stated to the committee that if a separate commission were organized for Chicago this commission should be appointed by the Governor and should be free from all connections with the city government.

The Commission has recently given out its decision in the case of the City of Beloit against the Beloit Water, Gas & Electric Company. The complaint involved both rates and service of all three utilities. The decision is a very exhaustive statement of all the facts as the Commission found them. The company has two schedules of rates for electricity, one being called the "residence rate" and the other the "business rate." The residence rate reads as follows:

First	25 kilowatt-hours, 15 cents per kilowatt-hour (net).
Second	25 kilowatt-hours, 12 cents per kilowatt-hour (net).
Third	25 kilowatt-hours, 8 cents per kilowatt-hour (net).
All over	75 kilowatt-hours, 6 cents per kilowatt-hour (net).

The second rate which all consumers in the down town district had the option of choosing was as follows:

A fixed charge of 10 cents per month per 55-watt lamp or less plus $1.10, less 25 per cent discount.

A current charge of 5 cents per kilowatt-hour. A discount of 25 per cent on the current charge for prompt payment. The minimum bill was the fixed charge.

The Commission found that the rate schedule was unjust to the residence and other small consumers and stated: "It is apparent that the reduction which can be made to electric consumers in Beloit must largely be given to those who have been paying under the so-called residence rate. No facts have been found in connection with this or other investigations of utilities of this class which warrant the giving of lower rates to business consumers than to residence consumers under the conditions which prevail in Beloit. The facts show quite clearly that the residence consumers in Beloit have been compelled under the existing rate schedule to bear more than their proper share of the cost of the service rendered. Current has been sold to large business users at rates so close to, if not actually below, the cost, that residence and other small consumers have been forced to return to the plant most of the profits of the business as a whole. Such a condition is not uncommon in the electric utility business or in other utilities. In the case of Beloit this situation is found in all three departments of the respondent business. Such a policy has apparently tended to prevent even a reasonable development of the residence business. That this class of business is profitable when properly developed has been demonstrated repeatedly."

The Commission presents a table showing a comparison of the development of business by all the electric utilities in cities of over 10,000 population in the state. A summary of the facts shown in the tabulation is given below.

	Maximum.	Minimum.	Av'ge.
Light consumers per 100 population.....	13.6	3.3	7.8
Residence consumers per 100 population..	9.9	1.3	4.8
Power consumers per 100 population.....	1.2	.25	.46
Total consumers per 100 population.....	14.35	3.57	8.43
Average receipts per lighting consumer...	$ 47.27	$22.35	$ 33.50
Average receipts per power consumer.....	349.30	18.38	125.70

Beloit showed a development of 5.8 lighting consumers per 100 population, 2.6 residence consumers per 100, and total consumers of 6.07 per 100. The average yearly receipts per lighting consumer in Beloit were next to the highest in the list at $43.98. The decision shows a comparative study of the electric-consumer data of several of the Wisconsin cities, the twelve-month residence consumers being analyzed with special thoroughness. In the case of all the plants included in the study the plants had submitted cards showing for each consumer the monthly consumption, the monthly bill and the size of the installation and the class under which the particular consumer came. This data covered a year's operation.

The Commission ordered the company to discontinue its present rate for residences and other small consumers and to substitute a schedule based upon the hours daily use of the active connected load. The classification of consumers according to active connected load percentages is practically the same as in the Madison case. The rate reads:

Primary Rate: 12 cents net or 13 cents gross per kilowatt-hour for current used equivalent to or less than the first thirty hours use per month of the active connected load.

Secondary Rate: 7 cents net or 8 cents gross per kilowatt-hour for additional current used equivalent to or less than the next sixty hours use per month of the active connected load.

Excess Rate: 4 cents net or 5 cents gross per kilowatt-hour for all current used in excess of the above ninety hours use per month of active connected load.

The company is also ordered to make a canvass of all electric consumers in the city of Beloit to determine the connected load of such consumers and the company is further ordered to plainly state on the consumer's monthly bill the size of that consumer's connected load and the per cent which is considered active in computing the bill.

LIGHTING AND POWER.

(Special Correspondence.)

MANCHESTER, IA.—The council voted to install electroliers on Franklin Street. C.

MINDEN, NEB.—This city has voted electric light bonds to the amount of $15,000.

FOND DU LAC, WIS.—The City Council voted to install a system of ornamental street lights. C.

ALICE, MINN.—This city is about to vote on an electric-light and waterworks bond issue of $150,000.

ATLANTIC, IA.—The council is unable to finance the installation of electrolier system of lighting. C.

GLEN ULLIN, N. D.—An electric light plant will be installed. C. E. V. Draper, engineer, Mandan, N. D. , C.

FLORESVILLE, TEX.—J. H. Bell, of San Antonio, will install an ice factory and electric light plant here. D.

MINDEN, NEB.—Bonds for $15,000 for the construction of a municipal electric light plant have been voted. C.

ANAHEIM, CAL.—Preparations are being made for an electric lighting system for the streets of this place.

LOS ANGELES, CAL.—The city council has authorized a bond issue of $3,500,000 for power-plant construction.

LITTLE FALLS, MINN.—The American Engineering & Con-

struction Company of Cleveland, O., has applied for an electric light, power and car franchise here.

DES MOINES, IA.—There is an agitation for the installation of two blocks of electroliers on West Locust Street. C.

KIRKWOOD, MO.—The city has decided to vote on bonds for $10,000 for the improvement of the electric light plant.

PLANKINGTON, S. D.—A franchise has been granted to W. A. Kuntze for the installation of an electric light plant. C.

NEW HAMPTON, IA.—The council voted to install boulevard lights on Main Street. There will be thirty-six standards. C.

FLORESVILLE, TEX.—J. H. Bell, of San Antonio, Tex., is considering the establishment of an electric light plant here.

BROWNS VALLEY, MINN.—This city is about to vote on an issue of $10,000 in bonds to establish an electric light plant.

SACRAMENTO, CAL.—The Sacramento Electric Gas & Railway Company has purchased a site for a new office building.

MOBRIDGE, S. D.—M. T. Woods, city auditor, will receive bids up to noon, August 7, for furnishing fourteen electric light standards. C.

ELLENSBURG, WASH.—It is proposed to issue bonds for $100,000 for the improvement of the municipal electric light plant here. C.

ROCKFORD, ILL.—The Rockford Electric Company will run transmission lines to Forrest, German Valley and other towns in the vicinity. Z.

MENARD, TEX.—E. C. Clark, of Chicago, is arranging to install an electric light plant, ice factory and a waterworks system here. D.

BARABOO, WIS.—The special lighting committee of the council recommends the construction of a municipal street-lighting plant. C.

GRASS VALLEY, CAL.—The street-lighting system at Grass Valley, Cal. has been changed from arc lights to tungsten lamps. A.

DES MOINES, IOWA.—The Urbandale Improvement League is arranging for the installation of an electric light plant in Urbandale. C.

GREAT FALLS, MONT.—The Great Falls Power Company is planning the construction of a power line to Billings, through Gudith Gap. C.

EL DORADO, ARK.—The El Dorado Light & Power Company has been granted a new franchise, and new machinery will be installed.

POCAHONTAS, IA.—A vote will be taken August 14 on issuing bonds for $11,000 for the construction of an electric light and power plant. C.

PRATTVILLE, CAL.—The Great Western Power Company has acquired a site in this district, and contemplates the erection of a large power plant. A.

EDWARDSVILLE, ILL.—One of the aims of the new Citizens' Park Association, which soon will be incorporated, is the installation of electric lights. Z.

POMONA, CAL.—The City Council has awarded a contract for lighting their city for a period of five years to the Southern California Edison Company. A.

RAWHIDE, NEV.—The Rawhide Queen Coalition Mines, Rawhide, Nev., will abolish its present gasoline engines, and install electric operating equipment. A.

WEBSTER CITY, IA.—The council appropriated $10,000 for the municipal electric light and power building for the construction of which C. E. Atkinson has the contract. C.

KIRKWOOD, MO.—A special election has been called for August 19 to vote upon the proposition to issue $10,000 bonds for an extension of the municipal electric lighting plant. Z.

CONCONULLY, WASH.—J. D. Morton has been granted a franchise for an electric lighting system for this town and expects to have it in working order within the next few weeks.

ARENZVILLE, ILL.—A stock company will be organized here it is reported to provide water and lights for the village. The current will be brought by a transmission line running from Beardstown. Z.

JACKSONVILLE, IND.—The town board has notified the Indiana Electric Trasmission Company, which operates light and water plants here, that the systems and service must be immediately improved. S.

LAS CRUCES, N. M.—The $75,000 bond issue of the Las Cruces Electric Light & Ice Company has been sold and the proceeds will be used for extentions and additions, and to cover present indebtedness.

GOLDENDALE, WASH.—The Northwestern Electric Company is now at work on the dam and large power plant on the Big Klickitat River near this city, on which the company will spend about $600,000.

JASONVILLE, IND.—The Reliance Engineering Company, which operates the water and light plants here, has been asked to improve both plants so as to improve the service. This the company has agreed to do. S.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has commenced construction on a new power line from Electra to Sutter Creek, Cal, a distance of twelve miles. The estimated cost of the work is $25,000. A.

ANGLETON, TEX.—The Angleton Gin & Power Company is installing a new cotton gin here. The plant will also provide power for an electric light plant and ice factory which the company will install later. D.

SPRINGFIELD, ORE.—A new street-lighting system will be installed here. Magnetite arc lights will be used in the business district, and tungsten lamps through the residential portion. The installation will commence at once. A.

ROLAND, IA.—J. A. Christian, city clerk, will receive bids up to 3 p. m., August 15, for the construction of an electric light system. Ames Engineering Company, engineer, Ames, Iowa. Grover & Wickham, consulting engineers. C.

SHIRLEY, IND.—The business men of Shirley are installing poles, wires and apparatus necessary for the use of electricity for light and power. Current will be furnished by the Indianapolis & New Castle Traction Company. S.

LINTON, IND.—The City Council has decided to move and rebuild the municipal electric light plant. The plant will be rebuilt almost in its entirety and considerable new machinery and apparatus installed. The estimated cost is $10,000. S.

PEORIA, ILL.—Ornamental lighting was given impetus when the city council passed a resolution that the city agree to furnish the current for cluster lights installed and that a fund for this purpose be included in the next appropriation ordinance. Z.

NEW BRAUNFELS, TEX.—The taxpayers of New Braunfels have voted to issue $67,000 of bonds for the construction of a dam across the Guadalupe River here and other improvements. A hydroelectric plant and waterworks pumping station will also be installed at the dam. D.

MITCHELL, IND.—James P. Goodrich and others, of Winchester, Ind., have purchased the Mitchell Electric Light Plant, and will enlarge and improve the system. The purchasers will also install a new water works system to be operated in connection with the light plant. S.

WARREN, IND.—The Town Board is preparing to install electrical apparatus for taking current from the high-tension lines of the Muncie, Bluffton & Eastern traction line to furnish a day current for Warren. The warehouses, stores, factories and newspaper offices will be supplied with current for power purposes. S.

MARTINSVILLE, IND.—The city council is taking steps to improve the municipal lighting plant. The city has outgrown the present plant and an appropriation has been made to enlarge and improve it so that ample current will be supplied for years to come. Some new machinery and apparatus will soon be installed. S.

MISSION, TEX.—The Mission Land Improvement Company has promoted the construction of a system of waterworks and the installation of an ice and electric light plant. For the waterworks system a 50,000-gallon reservoir will be constructed and a 50,000-gallon steel standpipe erected. A pumping plant will also be installed. D.

SACRAMENTO, CAL.—The Sacramento Valley Power Company is planning for the construction of a transmission system to the Shasta mining district, Cal., about fifty miles. The company also contemplates the erection of new power plants in this section. Herbert Fleishhacker, San Francisco, is at the head of the corporation which controls this company.

SUMMITVILLE, IND.—The town board having defaulted in the payment of amounts due the contractors who installed the lighting plant here, the contractors have taken over the plant and will operate it. Current will be secured from the Indiana Union Traction Company and many new street lights installed. The consumers will use meters and the rate is yet to be determined. S.

MILFORD, MASS.—The Milford Electric Light & Power Company has just begun extensive alterations to the wiring system on Main Street. The old single-phase system which has been in use for years, is to be replaced by a three-phase system. This, it is claimed, will give more regularity to the lights about town. Much improvement has also been made to the apparatus at the power house.

AUSTIN, TEX.—The City Commission has accepted the proposition of the Hydraulic Properties Company of New York for the construction of a dam across the Colorado River and the installation of hydroelectric plant, the agreed consideration being $1,600,000. The proposed contract will be submitted to a vote of the people of the city for ratification or rejection. The date of the election has not yet been named. D.

HOUSTON, TEX.—The City Council of Houston has granted a franchise to the Houston Electric Company and the Galveston-Houston Interurban Electric Railway Company for the use of streets of that city for their proposed lines. The franchise also gives the two companies the right to enter into supplemental con-

tracts with each other for the joint use of tracks in Houston. Both companies are owned by Stone & Webster, of Boston, Mass. D.

FORT WORTH, TEX.—The Fort Worth Power & Light Company, recently formed with a capital of $3,560,000, has taken over the holdings of what was known as the J. R. Nutt syndicate, embracing electric light plants, street railways and other valuable franchises. Among the directors of the new company are: J. R. Nutt, of Cleveland, O.; George T. Reynolds, T. B. Yarbrough, W. C. Stripling, John P. King, and A. J. Duncan, of Fort Worth. D.

DEL RIO, TEX.—D. B. Chapin, who is promoting the construction of a large dam across Devils River and the establishment of a system of irrigation that will reclaim more than 100,000 acres of desert land in the vicinity of Del Rio, announces that a syndicate of New York men has agreed to finance the project, provided certain stipulations are complied with in the matter of securing the necessary lands. Mr. Chapin has obtained options on 90,000 acres of land and says that he will close contracts for 30,000 more acres. His plans also embrace the installation of a large hydroelectric plant and the construction of power transmission lines to a number of towns in West Texas. A number of industrial plants, among them being a cotton mill, is proposed in connection with the project. D.

SAN ANTONIO, TEX.—Dr. F. S. Pearson, of New York, and associates, who comprise the Medina Irrigation Company, are constructing a dam across the Medina River near here and also have under consideration in connection with that project the construction of an electric interurban railway that shall run from San Antonio to the site of the big reservoir and down the valley of the Medina River, where more than 100,000 acres of land are to be reclaimed by means of irrigation. It is proposed to install a large hydroelectric plant at the dam and generate power for the operation of the railway as well as for a number of other industrial enterprises that are to be installed. This proposed electric traction line will be about sixty miles long. The preliminary surveys are now being made. D.

KINGMAN, ARIZ.—The annual meetings of the stockholders and directors of Desert Power & Water Company were held at the office of the corporation at Kingman on July 8. The following are the officers elected for the ensuing term: F. A. Wilde, president; James H. Davidson, vice-president; F. A. Wilde, Jr., treasurer and general manager; W. A. Richardson, secretary. The officers, together with W. L. Peters, of Riverside, Cal., constitute the new board of directors. Contracts will at once be let for the enlargement of the present engine and boiler rooms and the installing of an additional 1,250-kilivolt-ampere direct-connected generator and two 1,000-horsepower boilers, with auxiliary apparatus. This will be the third addition to the plant within two years. This company supplies power to the largest mines in the district, as well as light and power to the city of Kingman and with the improvements now under way it will have the largest and best equipped central station in Arizona. Transmission line extensions are also being considered.

ELECTRIC RAILWAYS.

(Special Correspondence.)

VIRGINIA, MINN.—A franchise has been granted for the construction of a street railway. C.

SIOUX FALLS, S. D.—The Sioux Falls Traction Company will extend its line on Fifth Street. C.

EVELETH, MINN.—The council granted a franchise for the construction of a range electric road. C.

PERRY, IOWA.—A franchise has been granted to P. C. Dilenbeck for the construction of a street railway system. C.

WATERTOWN, S. D.—Ferris Brothers have petitioned the council for a franchise to install a street-car system. C.

BRIGHAM CITY, UTAH.—The Ogden Rapid Transit Company is planning to extend its line from this city to Logan. A.

BILLINGS, MONT.—The Billings Traction Company will shortly commence the construction of a street-car line. C.

ST. PAUL, MINN.—Business men at White Bear are agitating for a shorter and more direct electric line to this city. C.

STOCKTON, CAL.—The work of laying rails for the San Joaquin Electric Railway was begun at Modesto last week.

SIOUX CITY, IOWA.—The Sioux City Service Company is considering the extension of its street-car line to Crystal Lake. C.

LOS ANGELES, CAL.—Arrangements have all been made for an electric car line through the Redondo Villa tract near this place.

SPRINGFIELD, ILL.—The Terre Haute, Robinson, Olney & Mt. Vernon Railway Company has surrendered its charter to the state. Z.

REGINA, SASK.—The council has been petitioned for and against the construction of a branch of the street railway to Scarth. C.

DAVENPORT, IA.—The contract to build three miles of interurban road was let to William Purcell, of Muscatine, Ia., by F. J. Peterson. C.

PORTLAND, ORE.—The Ladd Estate Company has commenced construction on its electric railway from Westmoreland to Eastmoreland. A.

MANKATO, MINN.—It is reported that J. J. Cummings, of Chicago, will extend the electric street-car line to Willmar, via Kasota and St. Peter. C.

BOSTON, MASS.—The Boston Elevated Railway Company has placed in operation twenty-five cars of the prepayment type on the Jamaica Plain-Dudley Street line.

DANVILLE, IND.—The Circuit Terminal Company is now completing a survey of a line between Lebanon and Sheridan. Construction work is to be started soon. S.

URBANA, ILL.—The Illinois Traction System will furnish power for the Kankakee-Urbana Interurban Railway until that company erects a power house, it is reported. Z.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has requested the War Department to permit an extension of its power system across the Willamette River. A.

WOODLAND, CAL.—The Vallejo & Northern Railway has been granted a franchise in Woodland. The company will soon commence construction on a line between this city and Sacramento. A.

FRESNO, CAL.—The Fresno, Hanford & Summit Lake Interurban Railway is planning for the erection of its proposed power plant. The company will extend its line from Fowler to Hanford, twenty-three miles. A.

FORT WORTH, TEX.—Work on the steel frame of the new substation of the Northern Texas Traction Company was started recently. It is expected power will be supplied to the downtown districts by September 1.

SPRINGFIELD, ILL.—The Illinois Traction System has purchased from the General Electric Company a 2,000-kilowatt Corliss engine for use in its power plant at Riverton, which recently was wrecked by an explosion. Z.

SAN BERNARDINO, CAL.—The Pacific Electric Railway (Los Angeles) announces that if right-of-way is provided, it will build a line from Upland to this city, via Rialto; and from Riverside to this city, via Colton. The grants for right-of-way for this road seem assured.

LAPORTE, IND.—Construction work has been begun on the Goodrum-Gary extension of the Air Line Interurban Company's line which has been completed from LaPorte to Goodrum, a distance of thirty-six miles. The company will build a double track from Gary to Hammond. S.

WOODLAND, CAL.—Construction work on the line of the Sacramento-Woodland electric line will begin at once and the officials of the road expect to have it in operation before the end of the year. Piers for the bridge over the Sacramento River are in and the steel is being placed.

RUSHVILLE, IND.—The Indianapolis & Cincinnati Traction Company, of which Charles L. Henry is president, has approved the plans and specifications for the erection of new passenger stations at Connersville, Shelbyville and Greensburg. These new stations will be modern in every respect. S.

FT. WAYNE, IND.—Official announcement has been made that the Ft. Wayne and Northern Indiana Traction Company would begin work immediately on the erection of car barns and shops to cost $175,000. The officials also announce that work will begin on the new passenger station in about four months. S.

ELKHART, IND.—The last spike in the St. Joseph Valley Traction Company's line connecting Elkhart with Middlebury, LaGrange, Angolia and other towns near the Ohio line was driven July 15 by Mayor Chester, of Elkhart. The road was constructed by H. E. Bucklin, of Chicago, a former resident of Elkhart. The first spike was driven in 1904. S.

SAPULPA, OKLA.—The way is now open for interurban connection between the cities of Tulsa and Sapulpa, the county commissioners of Creek County having granted the petition of the Oklahoma Union Traction Company for right of way. The request designates the route as in a southwesterly direction from New Tanaha to which point and beyond the grade is already completed.

MILWAUKEE, WIS.—Arrangements have been completed between the officials of the Milwaukee-Western railroad and the citizens of Hartford for an extension of the interurban line from North Lake to Hartford. About sixty per cent of the right of way already has been secured, and according to J. W. Barber, secretary of the Milwaukee-Western, the remainder will be under control of the company within a short time.

FORT WORTH, TEX.—The holdings of the Citizens' Railway & Light Company of Fort Worth which were sold at a receiver's sale on July 2 were purchased by different interests, the total consideration for the various properties being $660,000. The Northern Texas Traction Company acquired the Arlington Heights and Rosen Heights lines of street railway, embracing about twelve miles of track and all equipment and franchises, the price paid for these holdings being $400,000. The J. R. Nutt Light & Power Company of Cleveland, O., purchased the electric power plant and franchise for $250,000. It is the plan of the Northern Texas Traction Company to improve the two lines of railway that it has acquired and merge them into its present system. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

ELY, MINN—A Gamewell fire alarm sysetm will be installed here. C.

VIRGINIA, MINN.—The Mesaba Telephone Company is reconstructing its lines. C.

LENA, ILL.—The Independent Telephone Company is rebuilding its cable lines here. Z.

PALACIOS, TEX.—The Coast Telephone Company has been incorporated with a capital stock of $35,000.

TERRY, MONT.—The Montana Eastern Telephone Company has arranged to build another line to Marmarth, N. D. C.

BARLING, TEX.—The Citizens' Telephone Company has been incorporated with a capital of $10,000. Andy Gehebe is manager.

CENTRALIA, CAL.—The Hanford, Shookum Telephone Company has been incorporated by A. Bannso and W. Eshem for $1,500.

LOS ANGELES, CAL.—The Home Telephone Company is having plans prepared for a new station to be erected at Santa Monica, Cal. A.

WAUSA, NEB.—The Union Telephone Company will erect a two-story and basement building, 48 by 30 feet, for the postoffice and telephone exchange. C.

HICKMAN, NEB.—The Hickman Telephone Company has purchased the office building occupied by Dr. Reeves and will fit this building up for a central office.

LOS ANGELES, CAL.—The Automobile Emergency Service Company will install a telephone system for automilists' use on the highways on this entire section.

WACO, TEX.—The Home Telephone Company has been succeeded by the Brazos Valley Telephone Company, and the capital stock has been increased to $200,000.

KLAMATH FALLS, ORE.—A seventy-five-mile telephone system is to be constructed in the Crater National Forest Reserve, near here, under the direction of Supervisor Erickson. A.

CLINTON, IA.—The annual meeting of the stockholders of the Tri-City Automatic Telephone Company was held and the directors elected. The day after the election of officers took place.

KLAMATH FALLS, ORE.—The Pacific Telephone & Telegraph Company will soon commence work on the enlargement of its plant and system here. C. H. Moore, of Portland, is district commercial superintendent. A.

VENTURA, CAL.—The Pacific Telephone & Telegraph Company will build three new trunk lines to Santa Barbara, and a new line to Oxnard. The local station will be remodeled and improved and new equipment installed. A.

ELY, NEV.—The Forest Service will soon commence the construction of a telephone line from this city to Berry Creek and Spring Valley. Settlers in this territory will be allowed to install connecting telephones and use this line. A.

GREENSBURG, IND.—The Decatur County Telephone Company has just completed the installation of a new automatic exchange. The new exchange is said to be one of the most complete and modern of any automatic plants in the country. S.

SAN DIEGO, CAL.—The Home Telephone Company will extend its system to Brooklyn Heights and Inspiration Heights; a new substation will be erected on Normal Heights. The number of telephones in use will be augmented seventeen per cent and the work to be done will cost $35,000. A.

DUNLOW, W. VA.—The Wayne Dunlow Telephone Company was incorporated to construct and operate a telephone line. The capital stock is $5,000. The incorporators are S. W. Porter, J. H. Thornburg, of Dunlow; T. J. Preston, of Quaker; W. E. Hardwick, of Genoa; D. E. Hardwick, of Wayne.

LOS ANGELES, CAL.—The Pacific Telephone & Telegraph Company has completed its 150-mile extension to the Coachella Valley, Riverside County, Cal., placing the system of the Coachella Valley Home Telephone Company in connection with the entire southwest. The line was opened to service July 10.

GLANDIVE, MONT.—Another move to bring the Twin City and Montana into closer business communication is about to be made in the construction of a telephone line from Terry, Mont., to Marmarth, N. D., both towns being important points on the Puget Sound railroad. This project is being undertaken by the Montana Eastern Telephone Company.

SHERIDAN, IND.—The Bakers Corner-Horton Telephone Company has been incorporated, capitalized at $6,000. The new company is in the market for material and equipment for the installation of a telephone exchange and telephone system at Bakers Corner and throughout Hamilton County. Frank M. Folk, Charles B. Jones and Ernest Hodson are directors. S.

AUSTIN, TEX.—The Southwestern Telegraph & Telephone Company has acquired the property of the Texas Telegraph & Telephone Company, consisting of six local exchanges and 400 miles of toll lines. The exchanges are at Burnet, Llano, San Saba, Marble Falls, Fredericksburg and Mason, with toll lines connecting the exchanges. The consideration was $60,000.

ELECTRICAL SECURITIES.

The New York, New Haven & Hartford's expected financing has been practically arranged through the sale of $17,200,000 of the four and one-half per cent bonds of the New York, Westchester & Boston, a subsidiary, to bankers. It is expected that an early offering of the securities will be made by New York and Boston bond houses. The New York, Westchester & Boston is building an electric road from One-hundred-thirty-eighth Street, New York, to Portchester, with a branch from Pelham to White Plains, a total of 110 miles. The new line has an authorized issue of $20,000,000 first mortgage bonds, which have been held in the New Haven's treasury. The latter guarantees the issue.

In the fiscal year ended June 30 last the street railway lines of the Boston Suburban Electric Companies showed a 4.11 per cent increase in gross earnings and a 45.74 per cent increase in surplus available for dividends. The large increase in net earnings was made possible by the reduction in the percentage of operating expenses to gross business from seventy-five per cent in the 1909-10 fiscal year to seventy-three per cent in the fiscal year just closed. The Middlesex & Boston Street Railway Company paid five per cent in dividends during the past year, but the Lexington & Boston Street Railway Company paying nothing, in fact, its operations showed a deficit of about $12,000.

The rehabilitation of the Lincoln Gas & Electric Company has been finally arranged and the approval of the Nebraska Public Service Commission has been secured. The first step will be the offering on August 1 of $500,000 six per cent three-year notes, the proceeds of which will be used to meet $333,000 six per cent bonds maturing September 1 next and to liquidate floating indebtedness. These notes are to be offered by A. B. Leach & Co. on a five and one-half per cent basis. At an early date the stockholders will be asked to authorize $750,000 eight per cent preferred stock. Of this $500,000 will be used to retire the above mentioned $500,000 three-year notes and the balance—$250,000—will be offered in exchange for $750,000 of the present common stock, reducing the same to $1,500,000.

DIVIDENDS.

Boston & Northern Street Railway Company, regular semi-annual dividend of $3 on the first preferred stock payable August 1 to stock of record July 25.

Riverside Traction Company, a dividend of $5 per share, payable August 30; also a dividend of $5 per share, payable November 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	July 31.	July 24.
Allis-Chalmers common	$	$
Allis-Chalmers preferred	28⅛	28½
Amalgamated Copper	66⅞	69⅛
American Tel & Cable	*78	*78
American Tel. & Tel.	136⅜	136⅝
Brooklyn Rapid Transit	81	82¾
General Electric	162¼	162
Interborough-Metropolitan common	17¾	17⅞
Interborough-Metropolitan preferred	50	51
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	86	86
Mackay Companies (Postal Telegraph and Cables) preferred	74	74⅛
Manhattan Elevated	136	138
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	47	47
U. S. Steel common	79¼	80
U. S. Steel preferred	119¾	118¾
Western Union	79¾	81⅜
Westinghouse common	73⅜	75½
Westinghouse preferred	118¼	*111

BOSTON.

	July 31.	July 24.
American Tel. & Tel.	136⅜	136⅝
Edison Elec. Illuminating	285½	285
General Electric	162¼	162½
Massachusetts Electric common	22¼	23
New England Telephone	147	145
Massachusetts Electric preferred	92½	93¾
Western Tel. & Tel. common	20	21¼
Western Tel. & Tel. preferred	99	97

PHILADELPHIA.

	July 31.	July 24.
American Railways	44¼	44
Electric Company of America	12	12½
Electric Storage Battery common	55	55½
Electric Storage Battery preferred	55	55½
Philadelphia Electric	17¾	17¾
Philadelphia Rapid Transit	22¼	22½
Philadelphia Traction	86½	86¾
Union Traction	51⅜	51⅞

CHICAGO.

	July 31.	July 24.
Chicago Elevated common	27	28½
Chicago Elevated preferred	92½	92½
Chicago Railways, Series 1	95	87½
Chicago Railways, Series 2	28	27¼
Chicago Subway	3½	3⅝
Chicago Telephone	122½	123
Commonwealth Edison	135	135
National Carbon common	111	112
National Carbon preferred	117	118

PERSONAL MENTION.

FLOYD T. LOGAN, advertising manager of the Central Electric Company, Chicago, Ill., was married on July 6 to Miss Bernice Rhode, of Duluth, Minn.

ALANSON P. LATHROP, president of the American Light & Traction Company, New York, N. Y., sailed recently on the *Olympic* for a vacation on the Continent.

L. M. LAX, for the last eight years wire chief for the Central Union Telephone Company at Edwardsville, Ill., has been made plant chief in charge of the exchanges at Edwardsville, Highland and Collinsville. He is succeeded by O. E. Herrin of Alton. Z.

C. F. ZIEGLER, president of the Reynolds Electric Flasher Manufacturing Company, Chicago, who recently went to New York City to open an office in order to properly handle the company's Eastern business, spent a few days in Chicago last week.

R. B. STEARNS, of Chicago, general manager of the Chicago & Milwaukee Electric Railway, during the receivership of that line, has been appointed assistant general manager of the Milwaukee Electric Railway & Light Company, with headquarters in Milwaukee.

L. H. DAVIDSON, who has been assistant secretary of the Board of Supervising Engineers Chicago Traction, since its organization, has been appointed to the position of secretary and auditor to fill the position made vacant by the resignation of F. K. Parke.

S. W. DIETRICH, chief electrician for the Chicago & Alton railroad, has resigned his position to become superintendent for the San Joaquin Light & Power Company of Fresno, Cal., effective August 1. J. W. Thomas, chief electrician for the Toronto division of the Grand Trunk, will succeed Mr. Dietrich. He will have headquarters at Bloomington, Ill. Z.

F. I. HARDY, who for six years was connected with the Indiana Union Traction Company and later became general superintendent of the Fort Wayne & Wabash Valley Traction Company with headquarters in Fort Wayne, has been appointed superintendent of transportation of the latter road. This appointment is in the nature of an advancement, the office of general superintendent having been abolished.

H. W. YOUNG, president of the Delta-Star Electric Company, Chicago, and sales manager of the Sangamo Electric Company, Springfield, Ill., has just returned from an extensive Western trip in the interest of both companies. He made a careful investigation of the distribution and metering problems of power companies endeavoring to develop business along the high-tension lines and feels convinced that it is a field that can be made very profitable by the use of weather-proof equipment, which will eliminate the necessity of substations, thus materially reducing the fixed and operating charges.

C. L. GLASGOW has been appointed Montreal district sales manager of Allis-Chalmers-Bullock, Limited. Mr. Glasgow has had extensive experience in the construction of electric railways and the design of power plants. After graduation he was in the employ of the engineering and contracting firm, Westinghouse, Church, Kerr & Company, for five years, and was one of the engineeers in connection with the construction of the Lackawanna & Wyoming Valley Electric Railwkay and the electrification of the Long Island Railway. Later he was engaged in the electrification of the West Jersey & Sea Shore Railway and also with the Northern Colorado Power Company. Mr. Glasgow is a graduate of Cornell University in mechanical engineering.

LEGAL NOTES.

REQUIREMENTS FOR MAKING DIFFERENCES IN TELEPHONE RATES.—The Interstate Commerce Commission holds that, as between subscribers to a telephone service who are similarly situated, nothing but a difference in the service rendered or facilities furnished can justify a difference in the charges exacted. The fact that a few subscribers connected with a new exchange were previously connected with another exchange, which was abandoned by the company from motives of economy in management and efficiency of service, is not such a dissimilarity of circumstances and conditions as to warrant the exaction of the current charges from a new subscriber while for the same service and facilities the old subscribers continue to pay the lower charges formerly exacted at the old exchange. The contracts between such old subscribers and the company, even though valid when made, can not, after Congress has undertaken to regulate the rates and practices of telephone companies, be accepted as now justifying different charges as between different subscribers similarly situated, such undue discriminations being forbidden by the act.—Shoemaker vs. Chesapeake & Potomac Company, 20 I. C. C. 614.

EXTENSION OF RESPONSIBILITY FOR WIRES.—A case apparently different from any other so far decided was presented where two five-sixteenth-inch wires carrying an electric current of a high voltage were strung over a vacant lot in a thickly settled portion of a city. After some years the construction of a building on the lot was undertaken, and when it had reached a point where joists were being laid between the second and third floors at a distance of something over twenty feet from the ground, a carpenter took hold of the wires, possibly thinking that they were telephone wires, and was killed. The Court of Appeals of New York holds that the jury should have been allowed to decide whether or not the company was guilty of negligence, rather than that the court should have held as a matter of law that it was not guilty thereof. It says that it is not much impressed with the argument that it would be too burdensome to require an electric company to renew the insulation as frequently as necessary to make it effective. While the convenience of electric and telephone wires is obvious, and their maintenance should not be burdened with excessive liabilities, still it seems clear that a company maintaining dangerous wires should not be relieved, on the ground of expense, from the affirmative duty of exercising a reasonable degree of care to maintain proper insulation, and thereby prevent accidents reasonably to be apprehended to those lawfully coming in the neighborhood of such wires. The court also holds that as a basis for responsibility it is not too much to charge a company stringing such wires with a notice of the gradual changes in the locality through which the wires pass. In earlier times the proposition that a man owned all of the space above his land commonly became, after a short distance, one of mere theoretical interest, but with the constantly increasing uses for upper space this is changing, and the subject is continually becoming more and more one of new and practical importance. This court has held, in opposition to earlier authorities, that an action of ejectment may be maintained for the removal of a telephone wire stretched at considerable height over a man's premises.—Braun vs. Buffalo General Electric Company, 94 N. E., 206.

NEW INCORPORATIONS.

ST. LOUIS, MO.—The Electric Resistance Company has been incorporated with a capital stock of $2,000.

PORTLAND, ORE.—The Gibson Storage Battery Company has been incorporated with a capital stock of $5,000.

TOLEDO, O.—The Hartmen Electrical Manufacturing Company has been incorporated with a capital of $10,000 by R. M. Hartmen.

KANSAS CITY, MO.—The Western Electric Installation Company has been incorporated with capital stock of $5,000. The incorporators are John B. Young, Ben F. Shambaugh and William L. Hall. Z.

NEW YORK, N. Y.—The Federal Electric Welding Company has been incorporated by William H. Sayre, Daniel J. Lynch and Lyman S. Stevens for $10,000. The company will engage in electric welding.

NEW YORK, N. Y.—The Selkirk Manufacturing Company has been incorporated, with capital of $5,000, to manufacture electric batteries. The incorporators are Auguste F. Zoelier and Robert B. Abbott.

NEW YORK, N. Y.—The Quickhelp Burglar Alarm Company has been incorporated by Fried & Czaki, with a capital of $5,000. The incorporators are Albert Hirsch, Edgar A. Hirsch and Gustave Neumeyer.

NEW YORK, N. Y.—The Rex Sales Company has been incorporated with a capital stock of $10,000 to manufacture electric machinery. Incorporators, John G. Hogan, Alexander J. Patton and James P. Hill.

NEW YORK, N. Y.—The New York Electric Fire Alarm Company has been incorporated to manufacture fire-alarm systems. The capital is $5,000 and the incorporators are John Mullen, Joseph W. Keeler and Frederick E. Klein.

CHICAGO, ILL.—The Efficiency Electric Company has been incorporated with capital stock of $100,000 to do a general electrical and manufacturing business. The incorporators are V. J. Johnson, Charles G. Johnson and Ralph G. Carpenter.

CHICAGO, ILL.—The Apex Electric Manufacturing Company has been incorporated with capital stock of $10,000 to do a general manufacturing and foundry business. The incorporators are John F. and Stanislaus Prince and John L. Wilson.

CINCINNATI, O.—The Grafton Electric Construction Company has incorporated to manufacture and deal in all kinds of electrical supplies. The capital stock is $6,000. The incorporators are George L. Abbott, W. F. Faust, John F. Caveney and William Archdeacon, all of Grafton.

PROPOSALS.

ELECTRICAL EQUIPMENT.—The Treasury Department, office of the Supervising Architect, Washington, D. C., will receive sealed proposals until August 30, 1911, and then opened for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting fixtures), of the United States Postoffice at Eufaula, Ala., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Eufaula, Ala., or at the Washington office at the discretion of the Supervising Architect.

ELECTRICAL SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on

August 15, for the following material, delivered at the places mentioned:

Article.	Quantity.	Place.	Schedule No.
Cable, interior communication.	55,000 feet	Brooklyn, N. Y.	3815
Do	19,000 feet	do	3815
Cable, night signal	50,000 feet	do	3815
Cable, steel wire, copper clad.	80,000 feet	do	3815
Conductor, double, plain	50,000 feet	do	3815
Conductor, double, silk	50,000 feet	do	3815
Cord, telephone	30,000 feet	do	3815
Dynamo	1	Portsmouth, N. H.	3816
Fans, combination desk and bracket.	Annual supply	Brooklyn, N. Y.	3816
Keyboards, night signal	10	Boston and Norfolk.	3816
Wire, bell	75,000 feet	Brooklyn, N. Y.	3815
Wire, double conductor, diving.	1,000 feet	do	3815
Wire, single conductor	64,000 feet	do	3815
Do	40,000 feet	do	3815
Wire, twin conductor	270,000 feet	do	3815

In writing for schedules, the number must be given.

INDUSTRIAL ITEMS.

THE BURGESS ELECTRIC COMPANY, Duluth, Minn., has secured the contracts for supplying the electrical equipment for the new ore docks of both the Soo Line and the Great Northern Railway.

THE UNITED STATES LIGHT & HEATING COMPANY, Niagara Falls, N. Y., reports that all of its works are operating full capacity notwithstanding that this is regarded as a dull season of the year.

THE SHELTON ELECTRIC COMPANY, New York, N. Y., is sending out an attractive folder descriptive of its vibrators, hair-dryers and therapeutic machines. The medical value of these devices when regularly used is emphasizd.

THE BRIDGEPORT BRASS COMPANY, Bridgeport, Conn., is sending out a timely little folder setting forth the advantages of "Phono-Electric" wire in a convincing way. Practical tests between this and other wire are urged by the manufacturers.

THE INDEPENDENT ELECTRIC MANUFACTURING COMPANY, Milwaukee, Wis., is distributing a blotter containing a calendar for the month of August and illustrating one of the company's direct-current speed controllers with under and overload release.

ALLAN STIRLING, Philadelphia, Pa., manufacturer of Maxim water-tube boilers and boiler-room equipment, is sending to the trade a blue-print of a 1,250-horsepower Maxim boiler equipped with Alison economizer and arch drum. A circular describing the equipment, giving efficiency, data, etc., accompanies the print.

THE JEFFERSON GLASS COMPANY, Follansbee, W. Va., describes Luceo glassware in an attractive booklet recently gotten out. The new types of Lucco reflectors and globes are illustrated and described and several efficiency curves are reproduced. Considerable illuminating-engineering data also forms a part of this publication.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., in the current issue of *Juice* describes Pelouze electric irons and toaster stoves, Peerless Mazda sign lamps, General Electric blowers, Fort Wayne meters and a line of miscellaneous material. The usual amount of "newsy" information which characterizes this publication is also in evidence.

THE AVERY SCALE COMPANY, North Milwaukee, Wis., is distributing a catalog describing and illustrating the Avery power-plant scales suitable for checking the amount of coal fed into boilers; also totalizing weighers for pumping plants, filtration plants and gas works. The catalog contains illustrated descriptions of numerous typical installations made by the company.

THE DELTA-STAR ELECTRIC COMPANY, Chicago, Ill., has issued a booklet devoted to an exposition of the Pittsburg weather-proof transformers for use in securing new business along transmission lines. Recommendations are made as to the best method of installation, lightning protection and grounding of the secondary system. A complete description is also given of Delta-Star high-tension specialties for both indoor and weather-proof mounting.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., recently shipped a large order of water-wheel generators and apparatus to South America. The shipment required eight cars; the generators being of such size that each bed plate took three-quarters of a flat car. The approximate weight of the apparatus in this one shipment was 300,000 pounds, or 150 tons. A large shipment of railway motors for South America was made at about the same time.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., announces that its main sales office, which for the past nine years has been located at the Company's works, 2115-19 Locust Street, will remove about September 1, to the fifth floor of the Equitable Building, northwest corner of Sixth and Locust Streets, St. Louis. This removal will bring the sales office of this company to the center of the business activity of the city, making it more convenient for visiting customers.

THE FORT WAYNE ELECTRIC WORKS OF THE GENERAL ELECTRIC COMPANY, Fort Wayne, Ind., is distributing bulletins Nos. 1130, 1131, 1132 and 1132, all under date of June 1. Bulletin No. 1130 is devoted to a description of Northern type K direct-current motors; bulletin No. 1131 to series incandescent street-lighting systems, giving illustrations of typical street-lighting installations; bulletin No. 1132 to multiphase revolving-armature alternators; and bulletin No. 1133 to single-phase type K-4 watt-hour meters.

THE F. W. WAKEFIELD BRASS COMPANY, Vermilion, Ohio, has ready for distribution an attractive folder illustrating some of the new designs in lighting fixtures produced by the company. Several departures in standard fixture design have been made, the company listing for the first time a line of Wakefield showerplate fixtures. In these designs the manufacturers have endeavored to combine the serviceable with the practical, a standard ceiling plate being used upon which any style of fixture may be mounted.

ROBERT W. PAUL, London, England, in exhibiting electrical instruments and scientific apparatus at the International Exhibition at Turin. A very complete catalog of the apparatus may be had by addressing the manufacturer. Among the new apparatus described are resistance coils compensated for temperature, new precision resistance boxes, technical resistance boxes, new designs of direct-current instruments for high sensitivity, constructed upon the unipivot principle, universal measuring instruments, alternating-current and high-frequency measuring apparatus, and pyrometric apparatus.

THE STEEL CITY ELECTRIC COMPANY, Pittsburg, Pa., has appointed Aylsworth Agencies Company, 143 Second Street, San Francisco, Cal., its Pacific Coast sales representatives. The Aylsworth Agencies Company will carry a large and complete stock of the various material of the company's manufacture for the convenience of the trade, including "Star" bushings, "Steel City" drawn-steel outlet boxes, "Fullman" adjustable and non-adjustable floor outlets, universal insulator supports, "Star" fixture stems, "Superior" fish wire, etc., enabling them to make prompt deliveries on all orders received.

THE INTERNATIONAL OXYGEN COMPANY, New York, N. Y., describes in a recent bulletin the I. O. C. system for producing pure oxygen and hydrogen. The generator described in this publication produces hydrogen and oxygen by electrolytic dissocation of water, the gases being produced in separate compartments. The process of generation and the apparatus are fully described, and an interesting table of the cutting power of oxygen at varying speed is given. One of the advantages of the gas generator as stated is that pure gases may be generated on the premises of the customer, and at the place where the cutting or welding is to be done.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., recently received an order from the Philadelphia Rapid Transit Company for thirty-two motor-car equipments for use on its elevated division, and fifty-two motor equipments for use on its surface division. The equipments for the elevated division consist of two 125-horsepower motors with Sprague-General Electric type-M control, while those for the surface lines consist of two sixty-horsepower 500-volt motors with K-36 control. The International Railway Company of Buffalo has placed an order with the General Electric Company for sixty equipments each consisting of two sixty-horsepower 500-volt motors with K-36 control.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has recently received an order from the Clinchfield Coal Corporation, Dante, Va., for six six-ton gathering locomotives and four ten-ton mine haulage locomotives. One of the ten-ton locomotives and five of the six-ton locomotives will be installed at their mines at Dante, Va., while the remaining one six-ton and the three ten-ton locomotives will be installed at Hurricane, W. Va. The Clinchfield Coal Corporation, after experimenting for two years with the various types of locomotives, especially the single-motor and two-motor types, has decided that the two-motor design is the more satisfactory, and has accordingly placed an order for this type.

THE U. S. ELECTRICAL MANUFACTURING COMPANY, Los Angeles, Cal., report the sale and installation of U. S. motors for individual drive during the month of June to the following Southern California concerns; Los Angeles Manufacturing Company, six motors, total seventy-five horse power; Washington Iron Works, twelve motors; Roberti Brothers, twelve motors; Western Sanitary Enameling Company, seven motors; Brenan Shoe Company, twenty motors; Artistic Hardware & Fixture Company, nine motors; San Francisco Elevator Company, eight motors; Diamond Laundry Company, seven motors; Royal Laundry Company, six motors; Charles C. Chapman, four motors; Brock & Feagans, four motors.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has consummated arrangements with the Mine & Smelter Supply Company by which the latter concern will act

as representative for the Wagner Company in the territory contributary to Denver, Salt Lake City, El Paso and Mexico City, Mexico. The Mine & Smelter Supply Company is the largest mining machinery house in the country. However, it does not confine itself to machinery and supplies required in the mining and smelting industry but also handles all classes of machinery in the districts covered by the stores and warehouses above enumerated. In each instance, the Mine & Smelter headquarters, virtually becomes a district office of the Wagner Company, and will carry a satisfactory stock and be equipped with the necessary sales and engineering talent to negotiate for the sale and installation of Wagner apparatus. O. H. Davidson, heretofore the Wagner representative at Denver, becomes head of the electrical department of the Denver house of the Mine & Smelter Supply Company. In Salt Lake City, F. E. Marcey, for several years manager of the Salt Lake City office of the Allis-Chalmers Company, is manager of the Mine & Smelter Supply Company's office. It is presumed that this new alliance will result in an increased use of the well known line of Wagner single-phase motors, polyphase motors, alternating-current generators, transformers and instruments in the territory covered.

DATES AHEAD.

Indiana Electric Light Association. Annual convention, South Bend, Ind., August 23 and 24.

Institute of Operating Engineers. First annual convention, New York City, September 1-3.

Old Time Telegraphers' and Historical Association and the United States Military Telegraph Corps. Thirtieth annual reunion, Atlantic City, N. J., September 5-7.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

Vermont Electrical Association. Annual meeting, Lake Dunmore, Vt., September 13 and 14.

International Municipal Congress and Exposition. Chicago, Ill., September 18-30.

Northwest Electric Light and Power Association. Annual convention, Spokane, Wash., September 21 and 22.

American Electrochemical Society. Twentieth general meeting, Toronto, Canada, September 21-23.

Illuminating Engineering Society. Annual convention, Chicago, Ill., September 25-27.

American Mining Congress. Thirteenth annual meeting, Chicago, Ill., September 25-30.

American Electric Railway Association and affiliated associations. Annual convention, Atlantic City, N. J., October 9-13.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) July 25, 1911.

998,594. GALVANOMETER. Frank Aronson, Evanston, Ill., assignor to Central Scientific Co., Chicago, Ill. Filed Sept. 16, 1910. A D'Arsonval galvanometer has a U-shaped permanent magnet pivotally mounted on the base for rotative adjustment about the axis of the movable coil.

998,635. ARMATURE. Benjamin P. Remy and Frank I. Remy, Anderson, Ind., assignors to Remy Electric Co., Anderson, Ind. Filed Aug. 19, 1909. The armature core of a magneto is in two similar parts each having two outer segmental extensions and a shank fitting the shaft. About each shank and fitting into the segmental extensions is a form-wound coil.

998,647. ELECTROMAGNETIC CONTROL SYSTEM. Henry L. Smith, Schenectady, N. Y., assignor to General Electric Co. Filed Oct. 27, 1909. A continuously running electric motor is connected to a centrifugal pump through an electrically controlled clutch. A float in the receiving tank is mechanically connected to a movable core in an alternating-current magnet coil in circuit with the clutch and by varying the impedance of the coil controls the clutch circuit.

998,649. INSULATOR-BRACKET FOR ELECTRICAL WORK. Frederick K. Spencer and Orville Bennett, Binghamton, N. Y. Filed Nov. 11, 1910. Perforated horizontal plates are secured to a perforated vertical plate which is provided with a rib brace.

998,653. FLOOR-CONTROLLER. August Sundh, Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed Nov. 11, 1907. An electric elevator has independently operative automatic control circuits for the motor governed by the doors at the floor landings and so arranged that the motor cannot be started until all doors are closed and no door can be opened until the motor stops.

998,662. CIRCUIT-CONTROLLING DEVICE. John B. Wiard, Lynn, Mass., assignor to General Electric Co. Filed Mar. 25, 1907. A single-phase motor provided with a phase-splitting starting device drives a small centrifugal air pump to which is connected a tank and air piston which opens the starting circuit when the motor attains a certain speed.

998,674. GUARD ATTACHMENT FOR TROLLEYS. George J. Burns, Youngstown, Ohio. Filed Aug. 17, 1910. On each side of the trolley wheel is an angle-lever guard arm balanced horizontally by a depending weighted pendulum.

998,677. DYNAMO-ELECTRIC MACHINE. William F. Dawson, Schenectady, N. Y., assignor to General Electric Co. Filed Dec. 19, 1904. Relates to a commutator construction with circumferential rings to secure the bars in place.

998,687. ARC-LAMP ELECTRODE. Emile J. Guay, Lynn, Mass., assignor to General Electric Co. Filed June 26, 1909. A titanium-carbide-electrode containing four and one-half per cent of free sulphur intimately mixed in the body of the electrode.

998,705. TELEPHONE-EXCHANGE SYSTEM. Ray H. Manson, Elyria, Ohio, assignor to Dean Electric Co., Elyria, Ohio. Filed Feb. 19, 1910. A cord circuit comprises automatic ringing means, a time relay, cut-off relays for disconnecting the cord plugs from the cord circuit and controlled by the connected subscribers, and means actuated by the time relays for disconnecting the ringing means from the line after a predetermined interval and for placing the cord circuit in condition to be disconnected.

998,719. TELEPHONE SYSTEM. Charles A. Simpson, Chicago, Ill., assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Filed Nov. 30, 1908. Relates to the relay control of a line-signal lamp associated with the cord circuit of a central-energy telephone exchange.

998,734. METHOD OF MANUFACTURING ROTATING BODIES FOR HIGH-SPEED MACHINERY. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Co. Filed Aug. 3, 1907. The central disk for high-speed alternators and the like is made by rotating it at such a high speed that the material is caused to flow, thus deforming it and producing stresses that tend to resist centrifugal force when the disk is rotated in normal service.

998,749. TREATMENT OF PRECIOUS METALLIFEROUS ORES. John Collins Clancy, New York, N. Y., assignor to Clancy Metals Process Co. Filed Mar. 17, 1910. Consists in subjecting the ore to a solution containing a thiocyanate, a soluble cyanide, and a soluble iodine compound, and electrolyzing the mixture.

998,759. COMBINED TYPE-WRITING AND ADDING MACHINE. Albert H. Ellis, Brielle, N. J., assignor to Wyckoff, Seamans & Benedict, Ilion, N. Y. Original application filed Nov. 1, 1899. Divided and this application filed June 12, 1911. Includes a group of contact points arranged upon a carriage, each point being the terminal of a circuit from the carriage to an adding-wheel-rotating mechanism, a gage arranged to slide along the frame of the machine parallel with the carriage, a contact-closer arranged upon the gage, and means controlled by finger-keys for completing the circuits.

998,766. ELECTRIC-CONDUCTOR SUPPORT. Warren E. Foote, Everett, Mass. Filed May 11, 1911. Combined with a main and a branch trolley wire is a support therefor comprising a supporting member to which the wires are firmly secured, and a switch member secured to the trolley wires and maintained in operative relation to the supporting member by the tension on the trolley wires.

998,786. ELECTRIC SWITCH. Charles Loeffler, Utica, N. Y. Filed Mar. 1, 1907. Upon the front of the switchboard panel is a hand lever, which by means of a toggle mechanism operates a pair of rods that reciprocate in bushings through the panel. Mounted on the rods are laminated contact bridges whose front faces bear against busbars below and circuit terminals above.

998,807. MEANS FOR AUTOMATICALLY ARRESTING TALKING-MACHINES. Arthur E. Spencer, San Francisco and Frank C. Thomas, Mill Valley, Cal. Filed Nov. 22, 1910. One side of an electric circuit is connected to a filament in advance of the needle; the other side is connected to a point near the end of the record. When the circuit is closed an electromagnet releases a brake at the edge of the record.

998,810. COMBINED TAPLET OR CROSSOVER AND RECEPTACLE. James S. Stewart, New York, N. Y., assignor to Annie Stewart, New York, N. Y. Filed Mar. 23, 1910. A porcelain base for attachment to a molding has secured to it a receptacle.

998,849. ELECTRIC LANTERN. Thomas M. Jenks, deceased (Harriet B. Jenks, administratrix), and Alfred W. Knutson, Galesburg, Ill.; said Knutson assignor to said Harriet B. Jenks. Filed Apr. 22, 1910. An electric portable railroad lantern contains a battery and an incandescent lamp and has a contact on the frame and one associated with the bail, so that the

circuit is closed and the lamp lighted when the lantern is lifted by the bail.

998,850. AUTOMATIC STEREOSCOPIC RADIOGRAPHY. Edwin W. Kelly, Philadelphia, Pa. Filed Apr. 5, 1911. Includes an X-ray tube, a source of energy, means for energizing the tube from this source, a plate carrier, means for automatically shifting it and the X-ray tube, and means for thereafter again automatically energizing the tube.

998,865. CAST ELECTRODE. Knut Tornberg, Lynn, Mass., assignor to General Electric Co. Filed Dec. 28, 1910. Is provided with one or more shells having hexagonal perforations anchoring the electrode material to the shell or shells.

998,868. INDUCTION-MOTOR. Martin O. Berthold, Indianapolis, Ind., assignor to Fairbanks-Morse Eelectrical Manufacturing Co., Indianapolis, Ind. Filed June 5, 1908. Relates to the construction of short-circuiting rings for the rotor.

998,885. SPARKING DEVICE. Wray Falwell, Boston, Mass., assignor to Wray Manufacturing Co., Boston, Mass. Filed Oct. 10, 1910. A spark plug consists of two detachable parts, one an inner electrode with its insulating sleeve and shield, and the other a shell electrode inclosing the shield.

998,892. SPARK-COIL. Albert J. Gifford, James J. Burns, and Benjamin S. T. Bishop, Worcester, Mass., assignors to W. H. Leland & Co., Worcester, Mass. Original application filed Nov. 6, 1908. Divided and this application filed Aug. 30, 1909. A receptacle for the coil into which the coil is secured by locking plugs.

998,895. ELECTRIC LAMP. William A. Harvey, Scranton, Pa. Filed Sept. 13, 1910. Comprises a receptacle having a reflector providing a reëntrant wall and batteries contained within the receptacle and spaced apart by this wall.

998,896. SHADE-HOLDER. Horatio C. Hawks, Newton, Mass. Filed Mar. 25, 1910. A shade support for an electric lamp socket comprises a split neck, a shoulder portion, projections on the neck, and a collar having a contracted end and grooves adapted to engage the projections on the neck.

998,922. CLAMPING AND SUPPORTING MECHANISM. Frank C. Peck, Wayne, Pa., assignor to Electric Service Supplies Co., Philadelphia, Pa. Filed Feb. 5, 1910. A clamp for holding trolley wires comprises a jaw having a collar, a second jaw having a head which passes through the collar, a nut engaging the head whereby the jaws are clamped on the wire, and supporting means engaging the head.

998,925. CIRCUIT-CONTROLLING APPARATUS. William M. Scott, Philadelphia, Pa., assignor to Cutter Electrical & Manufacturing Co. Filed Nov. 27, 1908. Combined with an automatic circuit-breaker which is also a remote controlled circuit-closing switch, is a solenoid for moving the main switch to normal position, an operator's switch for controlling the solenoid, a local switch normally closed for controlling the solenoid independently of the operator's switch, the local switch being closed after the main switch movement to normal position is initiated, and a member associated with the main switch for opening the local switch when the main switch opens.

998,945. STARTING-HEATER FOR CARBURETERS. Clarence W. Avery and Frederick E. Searle, Detroit, Mich. Filed Nov. 25, 1910. Includes an electric heating coil whose circuit is controlled by the movement of the valve.

998,976. ELECTRIC BRAKE. William Ford Moody, Denver, Colo. Filed May 20, 1910. The armature of an electromagnet draws a band brake around a pulley against the force of a spring.

998,982. METHOD OF PRODUCING HALOGEN-OXYGEN COMPOUNDS BY ELECTROLYSIS. Mathias Pier, Schlachtensee, near Berlin, Germany, assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. Filed Apr. 29, 1911. Consists in allowing the evolved chlorine gases to escape from the cell, absorbing the same in a liquid which absorbs and readily gives up chlorine gas, and returning the gas to the electrolyte.

998,990. CIRCUIT-BREAKER. Malcolm P. Ryder, White Plains, N. Y. Filed Apr. 9, 1904. The tripping coil is connected across the secondary of a current transformer in series with the main circuit.

999,019. COOLING DEVICE FOR TELEPHONE-TRANSMITTERS. Carl Emil Egnér, Stockholm, and Johan Gunnar Holmström, Saltsjö-Storängen, Sweden. Filed Nov. 2, 1910. In a telephone transmitter, the combination of a receptacle containing a cooling liquid exerting great resistance to the electric current and electrodes in direct contact with the liquid.

999,022. SPARK-PLUG ATTACHMENT. Charles T. Gaither and Louis H. Black, Youngstown, Ohio. Filed Jan. 5, 1911. Includes a slidably mounted contact rod carried by the head of the plug and adapted to be moved into contact with the base thereof to render the spark plug inoperative.

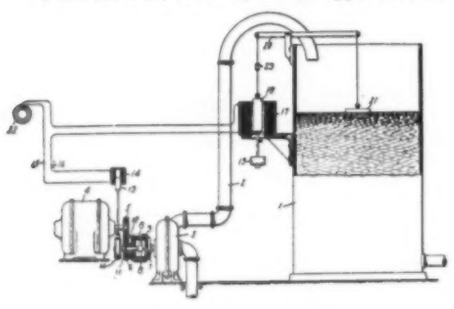
999,035. AIR-CIRCULATOR. James Keith, London, England. Filed July 16, 1909. A motor with a vertical shaft has mounted on the latter a double fan runner with tapering blades.

999,071. APPARATUS FOR PRODUCING CALCIUM CYANAMIDE. Frank S. Washburn, Nashville, Tenn., assignor to American Cyanamide Co., Baltimore, Md. Filed Mar. 4, 1910. A retort is provided with an electric resistance coil to heat the carbide to the temperature needed for the production of cyanamide.

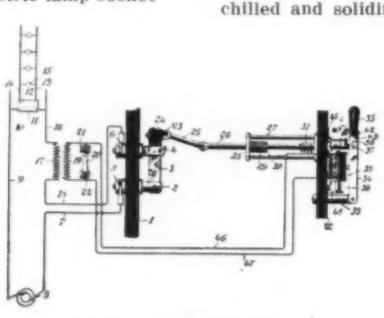
999,107. ELECTRIC-LIGHT FIXTURE AND HANGER. Frank Pinkney Harrison, Covington, Ga. Filed Dec. 19, 1910. Within the body of the fixture is a pendent rod having a weighted disk at its bottom to which the lamp hanger proper is secured.

REISSUE.

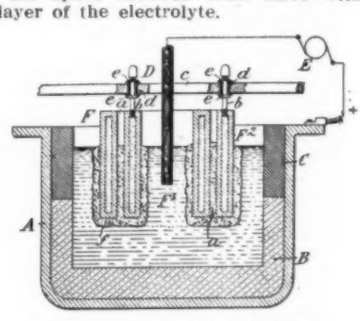
13,277. ELECTROLYTIC CELL. George O. Seward, East Orange, N. J., and Franz von Kügelgen, Holcombs Rock, Va., assignors to Virginia Laboratory Co., New York, N. Y. Filed May 19, 1911. Original No. 842,256, dated Jan. 29, 1907. A non-conductive partition for an electrolytic cell comprises a number of separated cooled curtains insulated from one another and adapted to maintain the space between them filled with a chilled and solidified layer of the electrolyte.



998,647-ELECTRIC PUMP CONTROL.



998,990-CIRCUIT-BREAKER.



13,277-ELECTROLYTIC CELL.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent office) that expired July 31, 1911:

523,662. ELECTRIC METER. Eugen Hartmann, Frankfort-on-the-Main, Germany.

523,663. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES. Joseph Hoffman, Schenectady, N. Y.

523,668. DYNAMO-ELECTRIC MACHINE OR MOTOR. Walter H. Knight, Lynn, Mass.

523,685. ARMATURE FOR DYNAMO-ELECTRIC MACHINES. Henry G. Reist, Lynn, Mass.

523,689. PROCESS OF MAKING SECONDARY-BATTERY PLATES. William L. Silvey, Dayton, Ohio.

523,695. ELECTRO-EXPANSION DEVICE. Elihu Thomson, Lynn, Mass.

523,696. DYNAMO-ELECTRIC MACHINE. Elihu Thomson, Swampscott, Mass.

523,704. ELECTRIC METER Thomas Duncan, Fort Wayne, Ind.

523,724. ELECTRIC SWITCH. George E. Linton, Worcester, Mass.

523,767. ELECTRIC SIGNAL FOR RAILWAYS. Charles Hammond, Boston, Mass.

523,776. ARMATURE FOR DYNAMO-ELECTRIC MACHINES. Horace F. Parshall, Lynn, Mass.

523,798. MEANS FOR TESTING ELECTRIC SIGNAL-BOXES. Jacob F. Mehren, Chicago, Ill.

523,805. ELECTRIC GOVERNOR. John A. Cabot, Cincinnati, Ohio.

523,822. ELECTROMAGNETIC RECIPROCATING PUMP. Charles J. Van Depoele, Lynn, Mass.

523,847. ELECTRIC SIGNALING APPARATUS FOR RAILWAY-TRAINS. William H. Baker, Pawtucket, R. I.

523,865. TESTING DEVICE FOR ELECTRIC CIRCUITS. George A. O'Neill, Boston, Mass.

523,893. BUSHING FOR ELECTRIC-ARC LAMPS. Thomas J. Houck, Baltimore, Md

523,927. MAGNETIC TELEPHONE. Frederick H. Brown, Chicago, Ill.

523,957. ELECTRIC WELDING OR BRAZING MECHANISM. George D. Burton, Boston, Mass.